SCIENCE ABSTRACTS.

Section A.—PHYSICS.

NOVEMBER, 1926.

GENERAL PHYSICS.

2497. *Size and Weight of Single Submicroscopic Spheres of the Order* $r = 4 \times 10^{-5}$ cm. **F. Ehrenhaft and E. Wasser.** (Phil. Mag. 2. pp. 30–51, July, 1926. Zeits. f. Physik, 37. 10–11. pp. 820–843, 1926.)—The method of observation of the particles was that of Ehrenhaft [see Abstracts 1471 (1910), 1372 (1911), 1913 (1925)], and consisted in the microscopic observation of single test bodies illuminated transversely. Measurements of rate of fall lead to the conclusions that the particles of one substance are of various sizes but of the same density. Particles or droplets of different substances conform to the same law of resistance to motion through a gas, *vis.* Knudsen and Weber's exponential law [see Abstract 432 (1912)]. The magnitude of a gold test body is determined by direct means, its size being 5×10^{-6} cm. and weight 1×10^{-11}. All the test bodies of gold, selenium and mercury are found to be spherical, and their electrical charges deviate from that of the electron in some cases by more than 20 %. Photographs of the spherical particles are shown, which were taken by means of ultra-violet light. G. E. A.

2498. *Device for Circulating Fluids under High Pressure.* **I. R. McHaffie.** (Faraday Soc., Trans. 22. pp. 147–149; Disc., 149, May, 1926.)—This device consists essentially of an electro-magnetically operated pump which by a suitable arrangement of valves produces a constant flow of gas in the desired direction. It has been used continuously for the circulation of air at pressures up to 100 atmos. and effected very efficient circulation. T. H. P.

2499. *Investigation of "Second" Levels.* **B. Wanach.** (Zeits. Instrumentenk. 46. pp. 221–238, May, 1926.)—The author has recently had the opportunity of examining the performance of more than a hundred levels, prepared by an important German firm, before they were attached to various instruments, and gives an account of the geometry, in which he shows that in an imperfect level the errors in the readings are accentuated when the length of the bubble is small. In some cases irregularities in the interior of the tube of molecular dimensions may cause measurable errors. Full details are given of the methods employed in taking the readings, recording them and working them up for a calibration, and particulars are given of levels reading to one second and others to two seconds of arc, with from thirty to eighty divisions. H. N. A.

2500. *The Cup Anemometer.* **J. Patterson.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 1–53, Jan., 1926.)—As no systematic attempt has been made since Robinson's time to find the most suitable type of cup anemometer, the author undertook a wind tunnel investigation and considered such factors as the length of the arm, size, number of the cups and constancy of the factor, and from the investigation he evaluated a general equation for all anemometers. The numerical results obtained are set out in a considerable number of tables. Among other results it is shown that the respective torques on the concave and convex sides of the cups are proportional respectively to $L(VR)^{2 \cdot 08}$ and $L(VR)^{1 \cdot 85}$. As there is this difference in the rate of variation of the torque on the two sides, it is not possible to get a cup anemometer with a constant factor. Neglecting the shielding of one cup on the other, and taking no account of the length of the arm or of friction, the following equation was obtained for the anemometer system: $\log f = 0 \cdot 6334 - 0 \cdot 12 \log V - 0 \cdot 15 \log R$. The conclusions reached, in conjunction with S. R. Ferguson, for a Canadian and U.S.A. standard pattern are (1) three cups instead of four, (2) cups of 5 in. diameter, (3) arms 6·3 in. long, and (4) a factor of 2·50. R. S. R.

2501. *A New Angle Inversor.* **O. Lacmann.** (Zeits. Instrumentenk. 46. pp. 320–321, June, 1926.)—Grüber's recent paper on inversors [see Abstract 663 (1926)] has induced the author to describe an angle inversor based on the known monographic solution of the equation, $1/a + 1/b = 1/f$. The paper is entirely geometrical, with three diagrams. H. H. Ho.

2502. *A Direct-reading Tacheometer.* **W. H. Connell.** (Journ. Sci. Instruments, 3. pp. 309–312, June, 1926.)—A direct-reading tacheometer devised by H. H. Jeffcott is described, in which two movable, cam-controlled stadia points enable the horizontal distance and the vertical height to be read off from the staff intercepts directly without calculation. AUTHOR.

2503. *A Simple Vacuum Arc Mercury Still for Laboratories.* **H. P. Waran.** (Phil. Mag. 2. pp. 317–320, July, 1926.)—The apparatus consists of an inverted U-tube of which when in use the two arms are nearly filled with mercury and an arc exists between the tops of the two mercury columns. One arm is connected to a mercury reservoir, which can be raised or lowered at will. The space above the mercury columns is connected through a large air-cooled condenser to a long vertical capillary tube and the whole air space maintained dry by connection with a bulb containing P_2O_5. The Hg vaporised in the U-tube will on condensation rapidly exhaust the reservoir and other spaces of all gases by a Sprengel pump action as the mercury falls down the U-tube. At this low pressure the mercury will boil at a relatively low temperature, and after the removal in the first ten minutes of the dirty mercury, that collected at the lower end of the capillary tube will be dry and of a high degree of purity. In addition the arc at the same time will serve as a bright source of light for many optical experiments. R. S. R.

2504. *Free Fall Apparatus.* **L. Behr** and **F. W. Reynolds.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 213–216, Aug., 1926.)—A description is given of apparatus constructed for undergraduate use in studying the laws of uniformly accelerated motion and in determining the value of gravity. The falling body has no constraints and the time may be measured with an ordinary watch. AUTHORS.

2505. *The Physical Properties of Glass and their Relation to Glass Composition. Part III. The Viscosity of Glass.* **G. Gehlhoff** and **M. Thomas.** (Zeits. techn. Physik, 7. 6. pp. 260–278, 1926.)—A continuation of previous work [see Abstract 1187 (1926)]. The viscosity of samples of glass of different systematically altered constitution was determined from the solid hard state right up to the thin liquid state. As measures of the viscosity the various physical properties were employed. In the solid state the electrical conductivity was measured at different temperatures, and thus conditions of equal viscosity were found for the various kinds of glass. The temperatures of equal viscosity were also found from observations of the velocity of bending of heated glass rods, and were measured for the various rods under standard conditions by the resistance to rotation of a body in molten glass. The relation between hardness and viscosity is deduced. Complete details and diagrams of the experimental apparatus are given, and the paper is full of comprehensive tables. S. G. B.

2506. *Viscosity of Water at Low Rates of Flow determined Comparatively by a Method of Thermal Convection.* **A. Griffiths** and **P. C. Vincent.** (Phys. Soc., Proc. 38. pp. 291–301; Disc., 301, June, 1926.)—The paper describes a method of determining the coefficient of viscosity of water by measuring the rate of convective flow in a long capillary tube, the driving head being obtained by the difference in density due to a difference of temperature between two vertical columns of water. The novel features appear to be (1) the method of obtaining the driving head; (2) the new method of introducing a coloured index in a closed capillary circuit, and an improved method of reading its position; (3) the almost complete elimination of what may be called the thermometric effect as distinct from the convective effect; (4) the elimination of the small residual thermometric effect from the final calculations. The results are in agreement with the conclusion reached in a previous article by A. Griffiths and C. H. Griffiths [see Abstract 25 (1922)], *viz.* that the viscosity of water at low rates of shear in glass tubes is apparently no different from that at high rates. AUTHORS.

2507. *Interfacial Tensions between Organic Liquids and Water or Aqueous Solutions.* **J. R. Pound.** (J. Phys. Chem. 30. pp. 791–817, June, 1926.)—The interfacial tensions between two mutually saturated liquids are determined by the capillary tube method described by Reynolds [see Abstract 1688 (1921)]. A measurement is made of the difference (h) between the levels of the two interfaces or menisci, the one in and the other out of the capillary tube in the scale divisions of the outer tube. If d and d' are the densities in c.g.s. units of the two liquids, r is the radius of the capillary tube in cm., μ is the value of one scale division of the outer tube in cm., the interfacial tension I is given by the equation: $I = h(d - d')(h + r/3\mu)$. Measurements are made in a thermostat at

30° C. with a large number of oils and organic liquids in contact with water and with aqueous salt and acid solutions. Fluctuations of the values occur particularly with impure liquids, and purification of an oil tends to produce a more constant and also a higher interfacial tension. The greater the mutual solubility between the two liquids the lower the interfacial tension. The difference between the surface tension of two pure liquids gives the maximum possible interfacial tension, which is the value that would obtain if they were completely immiscible. With aqueous solutions of salts, acids and bases, the interfacial tension of an oil is generally greater than with water in accordance with its lower solubility. Fluctuations in the values which are observed in a number of instances are attributed to chemical interaction between the liquids or to surface concentration changes through the presence of traces of impurities. J. N. P.

2508. *Coefficient of Viscosity of Water-Vapour.* **G. Mokrzycki.** (J. de Physique et le Radium, 7. pp. 188–192, June, 1926.)—By a capillary tube method and a method of oscillation it is found that the viscosity of air mixed with water-vapour differs little from that of pure air; also the diameter of the water particles has little effect on the viscosity. For particle diameters between 5×10^{-5} and 10^{-3} cm., and for vapour densities, Δ, between $1{\cdot}5 \times 10^{-6}$ and $1{\cdot}5 \times 10^{-5}$ gm./cm.^{3}, the coefficient of viscosity of moist air at 0° C. can be given as $0{\cdot}000171 + 1{\cdot}59\,\Delta$. Ionised air has the same viscosity as ordinary air. G. E. A.

2509. *Elasticity of Jellies of Cellulose Acetate in Relation to their Physical Structure and Chemical Equilibria.* **H. J. Poole.** (Faraday Soc., Trans. 22. pp. 82–101; Disc., 102–106, March, 1926.)—The load-strain curve for cellulose acetate jellies bends continuously towards the load axis, this behaviour indicating the existence of a sponge-like or fibrillary structure of solid material in the jelly. The elasticity (Young's modulus and the shear modulus) of these jellies of various concentrations of the acetate in a mixture of benzyl alcohol and water in constant ratio is approximately proportional to the square of the concentration. From this result, in conjunction with the deductions previously made [Abstract 19 (1926)], it is concluded that the material of the rigid phase exists as a result of a dynamic solvation equilibrium between the cellulose acetate and the solvent. Permanent deformation is not induced in cellulose acetate jellies by heating and cooling temporarily deformed specimens, the structure first formed on gelatine thus being mainly permanent and capable of change in elasticity by reason of changes in solvation rather than by dissolution into the liquid phase. Equilibrium in elastic properties is reached only after a considerable period following a change in temperature, this period being the greater if the jelly is cooled. The attractions between the cellulose acetate molecules which result in elasticity are thus strictly local, the sphere of effective attraction being smaller than the molecule itself. Measurements of the creep of these jellies under stress leads to the idea of a coefficient of inner resistance to denote the force normal to a face required to produce unit velocity of creep in unit cube of jelly in the absence of all elastic control. This coefficient runs parallel in magnitude with the viscosity of the parent sols. The effect of variations in solvent composition indicates that, as a solvent for cellulose acetate, benzyl alcohol is deficient in hydroxyl groups. Partial replacement of this alcohol by water produces decrease in elasticity and increase in solvation, whereas partial replacement by xylene gives the opposite results. T. H. P.

2510. *Strength Phenomena of Rock-Salt.* **W. Ewald.** (Zeits. techn. Physik, 7. 7. pp. 352–355, 1926.)—Rock-salt from Wieliczka has the tensile strength 1192 grammes per sq. mm. ± 1·2 %, whereas that from Stassfurt varies between 1400 and 1800 grammes per sq. mm. in strength. When coarsely ground, a prism of rock-salt shows increased strength, which is diminished by about 13 % by polishing. If, however, two crystals are ground and polished, and one then roughened, the two exhibit no difference in strength. In contradiction to the statement of Peters and Polányi, subjection of rock-salt crystals to about 80 % of the breaking load for 24–30 hours causes no increase in the strength. Compression of rock-salt at 750–800° in the direction of the cube-faces greatly increases the strength. Prisms of rock-salt with even slight coloration are considerably stronger than the colourless variety. Repeated bending to and fro lowers the bending strength of the salt. T. H. P.

2511. *Orthogonal Potentials.* **P. J. Daniell.** (Phil. Mag. 2. pp. 247–258, July, 1926.)—Orthogonal potentials are defined and introduced as an aid in applying the minimum energy method to problems in elasticity and hydrodynamics, including torsion, viscous flow and centrifugal force. The advantage of the method is that the formulæ can be applied directly to any particular case by the substitution of numerical values which depend only on second and higher moments, which are themselves calculable by simple quadratures. A. B. C. L.

2512. *High Temperature Tensile Properties of Metals.* **D. H. Ingall.** (Inst. of Metals, J. 34. pp. 171–182; Disc., 182–183, 1925.)—Describes work similar to that of an earlier investigation [see Abstract 756 (1925)], in which a definite load was applied to a wire and maintained while the wire was heated until it broke. In the previous work the rate of heating was 20° per min.; in the present work three uniform rates of heating were used, *viz.* 3°, 8° and 20° per min. The results show that the slower the rate of heating, the lower is the breaking temperature for any given load. Results are also given of high temperature tests on a series of brasses, from which it is concluded that brasses containing about 93 and 80 % of copper will only satisfactorily withstand temperatures up to 200°, while others will be suitable up to 250°. C. O. B.

2513. *Contribution to the Study of the Coefficient of Restitution.* **L. Martinozzi.** (N. Cimento, 3. pp. 207–212, May, 1926.)—Describes two series of experiments. The first was carried out with spheres of various radii and materials which were made to strike on a plane. In the second, an ovoid mass was used and made to strike the same plane with its vertices. Thus the curvature of the surface of impact could be varied without altering the mass of the striking body. The spheres were of tempered steel and glass, the ovoids of soft iron with vertices of tempered steel, the plane being always of the same material as the striking body. A bifilar pendulum was used, the bob composed of the material under examination. When at rest the bob was tangential to the vertical plane, which could be shifted in a direction parallel to itself. Two movable walls of brass plate served to regulate the starting point of the pendulum, the distance between them being given by a movable index with a micrometer screw measuring to $\frac{1}{10}$ mm. The pendulum was released by burning a thread which held it in position. Particular care was taken to ensure a perfectly central impact, this being indicated by the reflection of a luminous ray from a mirror attached to the bob. The formula used for determining the coefficient of restitution was $\epsilon = h'/h$, h being the chord of the arc described by the bob in falling, and h' that described by the rebound. The author claims to have established that the coefficient diminishes as the velocity of impact increases, provided the latter be subjected to marked variations. The results are worked out mathematically. E. F.

2514. *Theory of the Elasticity Limits and Rigidity of Crystalline Bodies.* **J. Frenkel.** (Zeits. f. Physik, 37. 7–8. pp. 572–609, 1926.)—In Part I of this paper the rigidity to compression of two different crystalline bodies is compared with the statical friction between them, and, based upon a model, the author sketches a qualitative conception of both phenomena in which the influence of temperature is also qualitatively discussed. Previous work by Joffé and by Georgieff and Schmid [see Abstract 1746 (1926)] is briefly mentioned. Part II gives the quantitative theory. For the calculation of the rigidity to pull and to compression an approximation process is employed in which the potential energy of two crystal sections is assumed to be a function of their relative displacement. This energy is evaluated for the absolute null-point of temperature on the ground of the electrical theory of the cohesion forces, and supplemented by an additional "non-Coulomb" energy, whereby approximately the moduli of elasticity and the corresponding rigidity limits (normal and tangential) are calculated. As a specific example the (100)- and (110)-planes of rock-salt are considered. The correction here required for volume deformation is found to be inconsiderable. The temperature dependence of the energy has been determined by means of the general statistical principles. For the moduli of elasticity a quantitative agreement appears to exist between theory and experiment. Only qualitative conclusions have been drawn for the corresponding rigidity limits, although these also agree with the results of experiment. The paper is mathematical throughout. H. H. Ho.

2515. *Experiments on the Fluctuations of Velocity in a Current of Air.* **J. M. Burgers.** (K. Akad. Amsterdam, Proc. 29. 4. pp. 547–558, 1926.)—The experiments were made in a wind channel with a pair of hot wire anemometers, having separate resistance-measuring apparatus, the motions of the mirrors of the two galvanometers being photographed simultaneously on the same strip of paper. In order to find the dimensions of the vortices in a direction perpendicular to the air stream, the two anemometers were placed at varying distances apart and records taken. It was found that when the wires were close there was very marked correlation between the records, but as the distance was increased to 1 or 2 cm. this correlation disappeared. This result also fixes an upper limit of 1 cm. to the length of wire that can safely be used. Near the wall, to investigate the dimensions parallel to the wall, a wire provided with six potential leads spaced at intervals of 5 mm. was used; it was found that the "boundary layer" was just over 2 cm. thick. With the two wires very close (0·1 to 0·2 mm.) the instrument is sensitive to variations of direction of the air stream. By a sum and difference method of connecting up the two galvanometers, this can be used to measure the fluctuations of the mean velocity and its direction simultaneously. Records showing these for points 50 cm. from the honeycomb are given, and its influence upon the stream is still quite marked. W. G. B.

2516. *Laws of the Frequency of Alternate Vortices detached behind an Obstacle.* **H. Bénard.** (Comptes Rendus, 182. pp. 1375–1377, June 7, 1926.)—The formula representing the results of a long series of observations is $N = \frac{0{\cdot}430}{D + 0{\cdot}307}(V - 166\,\nu)$ c.g.s. units, in which N = frequency, V = velocity, and ν = kinematic viscosity. This does not obey the laws of dynamic similitude. Irregularities in the spacing of the vortices are present in most cases, although great care was taken to have the water quite quiescent before an experiment, and the times taken for the vortices to decay are also capriciously unequal. W. G. B.

2517. *The Inexactness of the Theoretical Laws of Karman for the Stability of Alternate Vortices.* **H. Bénard.** (Comptes Rendus, 182. pp. 1523–1525, June 21, 1926.)—The author's experiments [see preceding Abstract] do not bear out the laws of Karman. In particular, the ratio of the distance between the vortices to the distance between the rows is not constant and equal to 0·283, but varies from 0·23 to 0·59, with a mean of 0·44. The other ratios, that of velocity of vortices to velocity of obstacle, and between spacing of vortices and width of obstacle, also vary between wide limits. W. G. B.

2518. *The Limit between Laminar and Turbulent Regions, as shown by the Appearance of Alternate Vortices.* **H. Bénard.** (Comptes Rendus, 183. pp. 184–186, July 19, 1926.)—The formula for the frequency of alternate vortices thrown off behind a moving object, given by the author [see preceding Abstracts], makes vortices impossible if V is less than 166 ν, *i.e.* if the Reynolds number is less than 166 D. This limit (extrapolated) is compared with the least value of the Reynolds number at which good photographs of vortices were experimentally obtained for the various thicknesses of obstacle employed. The experimental values are greater than the calculated, but range in the same order. The same is found in comparing results in which the viscosity of the liquid varies. W. G. B.

2519. *Law of Similarity and Use of Hydraulic Models.* **C. Camichel, L. Escande** and **M. Ricaud.** (Rev. Gén. d'Él. 20. pp. 54–60, July 10, 1926.)—The author first describes two experiments intended to test the validity of the law of similarity for the flow of liquids, and finds good agreement between the calculated and the experimental results. He then points out the great technical importance of the law of similarity and discusses the use of hydraulic models based on this law. When using small-scale models a serious difficulty arises in connection with the accurate measurement of velocity, which in small models is so low as to render the ordinary form of Pitot tube inapplicable. The author has devised a *differential* method of measuring low velocities by means of a special type of Pitot tube. In the closed circuit between the two orifices of the tube is included a small pump (carefully calibrated) provided with a tachometer. The speed of the pump is adjusted until there is no flow through the Pitot tube. A portion of the tube is made very narrow, and is viewed through a lens, the condition of no-flow being determined by observing the particles held in suspension, which will appear stationary when the flow ceases. The apparatus is capable of measuring velocities of the order of 5 cm./sec., corresponding to a difference of pressure of the order of 0·03 to 0·05 mm., which would be very difficult to determine by a direct method. A. H.

2520. *Theory of Ship Waves.* **E. T. Hanson.** (Roy. Soc., Proc. 111. pp. 491–529, July 2, 1926.)—Some of the known theory is recapitulated, and a discussion of the case of a ship moving parallel to a sloping shore is given, and also that of two superposed liquids of different densities. Mainly mathematical. W. G. B.

2521. *Experimental Determination of the Coefficient of Discharge of Nozzles.* **Rateau, Leroux** and **Bourgeat.** (Comptes Rendus, 183. pp. 259–266, July 25, 1926.)—Two sets of nozzles, one conical, the other having as section an arc of a circle, and all with rounded entry, were used. They were placed in the centre of the base of a closed cylindrical tank supplied by piping from a constant-level tank, and containing vanes to prevent any rotational motion of the water. The head could be varied over wide limits, and the plan adopted kept the tank constantly full, so that this head was maintained constant during an experiment. The larger diameter nozzles had a greater coefficient of discharge than the smaller ones, and this was especially evident at small heads. There was little difference between the results for the two profiles, but, if anything, the conical were slightly better. For some of the nozzles a plate with a cylindrical hole could be affixed, and this was found to increase the discharge by 1 or 2 %. W. G. B.

2522. *The Problem of the Mill.* **L. Lecornu.** (Comptes Rendus, 182. pp. 1361–1362, June 7, 1926.)—This note is in answer to the following question submitted to the author by a reader of his previous paper [see Abstract 2240 (1926)]: Given that the equilibrium state of a cylindrical mill may be obtained with an approximation the greater as the thickness decreases with respect to the diameter, may the equilibrium state of a cylindrical shaft of any length be deduced by regarding it as constituted of an infinite number of infinitesimally thin mills? Reasons are given for a negative reply. H. H. Ho.

2523. *Crystal Structure of Lead Iodide.* **P. Terpstra** and **H. G. K. Westenbrink.** (K. Akad. Amsterdam, Proc. 29. 3. pp. 431–442, 1926.)—PbI_2 crystallises in thin hexagonal plates doubly refracting, uniaxial, negative. The faces are bordered by an apparently hexagonal bypyramid. The $a : c$ by gonimetric measurements is given as 1 : 1·51. Laue photographs indicate an axis of three-fold symmetry and three-symmetry planes intersecting at 120°, and confirms the $a : c$ ratio. Powder photographs give $a = 4{\cdot}59$ Å.U. and $c = 6{\cdot}78$ Å.U. with one molecule per unit cell. It appears that PbI_2 is a trigonal crystal of rhombohedral symmetry. For the position of the iodine atoms with respect to the lead planes U = 1/5 gives the best agreement with intensities. J. E.

2524. *Crystal Structure of Red Mercuric Iodide.* **J. M. Bijvoet, A. Claassen** and **A. Karssen.** (K. Akad. Amsterdam, Proc. 29. 4.

pp. 529–546, 1926.)—The dimensions of the unit cell were determined by means of rotation diagrams using Polányi's formula [see Abstract 1141 (1922)]: $a = 4\cdot38$ Å., $c = 12\cdot43$ Å., and there are two molecules in the cell. Space group D_{4H}^{15} is the only one which fits the intensities observed in powder photograms. The atomic positions are Hg 000 $\frac{1}{2}\frac{1}{2}\frac{1}{2}$, I $0\frac{1}{2}v$ $0\frac{1}{2}v+\frac{1}{2}$ $\frac{1}{2}0\bar{v}$ $\frac{1}{2}0\frac{1}{2}-v$ with $v = (50 \pm 2\cdot5)/360$. Reproductions of photographs of models of the structure are given; they show that it is built up of a series of layers of HgI molecules in which each Hg ion is surrounded nearly tetrahedrally by four I ions. The distance between Hg and I (2·80 Å.) agrees fairly well with the sum of the atomic radii. The distance between successive layers is very large: from an I atom in one layer to the neighbouring Hg in the next layer is 4·98 Å. The excellent basal cleavage is explained by this arrangement in layers. The stability of the open marshalling may be explained, according to Hund, by taking into account the polarisation of the I ion. H. N. A.

2525. *Interatomic Distances in Crystals.* **W. L. Bragg.** (Phil. Mag. 2. pp. 258–266, July, 1926.)—The development of the theoretical aspect of X-ray analysis subsequent to an earlier paper [see Abstract 21 (1921)] is reviewed and the various methods of employing and interpreting the data are discussed, with particular reference to the utility, in crystal analysis, of the conception of atomic domains. A. B. C. L.

2526. *Explanation of the so-called Force of Crystallisation.* **C. W. Correns.** (Preuss. Akad. Wiss. Berlin, Ber. 11. pp. 81–88, 1926.)—The paper contains a brief survey of the literature of the subject and an explanation of the pressure developed during crystallisation. It is purported to show that the phenomena can be explained by either volume alteration, alteration of the state of aggregation, by chemical reaction or surface forces. The surface forces were exactly defined. The alteration of the potential of the limiting surfaces is also noted and discussed The paper is theoretical throughout. S. G. B.

2527. *The Symmetry of Sylvine and the Nature of Etch Figures.* **K. F. Herzfeld** and **A. Hettich.** (Zeits. f. Physik, 38. 1–2. pp. 1–7, 1926.)—According to Bragg, sylvine (KCl) is holohedric, but mineralogists have described it as hemihedric, *i.e.* of lower symmetry, and this has been apparently confirmed by observations of etch figures. The authors, however, after an investigation of these figures, have concluded that their apparent asymmetry is caused by minute traces of organic impurity on the surfaces of the etched crystals, and when proper precautions are taken to avoid such impurity the etch figures are perfectly symmetrical or holohedric, though at the same time they become very infrequent. H. N. A.

2528. *Atomic Weight of Silicon and Silicon Isotopes.* **F. M. Jaeger.** (Zeits. Elektrochem. 32. pp. 328–330, July, 1926. Paper read before the Deut. Bunsen Gesell., Stuttgart, May, 1926.)—Recent determinations by different workers give the atomic weight Si = 28·1. According to Aston silicon consists of two isotopes of mass 28 and 29 (and possibly a third, 30). With two isotopes the silicon atom should contain 90 % of Si 28 and 10 % of Si 29. The mixture ratio may be constant for inherent reasons, or simply on account of the age of the solar system. In the latter case the silicon in chondritic meteorites (possibly not belonging to the solar system) might differ from telluric silicon. The author determines the density of silicon tetraethyl Si $(C_2H_5)_4$, which resembles a liquid, exceedingly stable paraffin, easily purified. He prepares this compound from six European and also Pennsylvanian quartz and minerals and from six chondrites from various parts of the globe. The deviations from the mean atomic weight deduced from the densities found do not amount to more than 0·006 and 0·005 % in the two groups, and the compounds seem to be identical. Since isotopes have the same refractive index, there should be no differences in these indices. But the Haber-Löwe differential interferometer reveals slight differences. The conclusion drawn is that there is some trace of an impurity, but that the mixture ratio of the two isotopes is constant for inherent reasons. H. B.

2529. *The New Element of Atomic Number 61 : Illinium.* **B. Brauner.** (Nature, 118. pp. 84–85, July 17, 1926.)—The author in 1902 published his conclusion that an element with atomic number 61 remained to be discovered. The difference between the atomic weights of Sm and Nd is 6·1, greater than that between any two neighbouring elements. When the true hydrides of the eighth series of the periodic table are arranged according to atomic weights, the number of H atoms is seen to vary regularly : CsH_1, BaH_2, LaH_3, CeH_4, PrH_3, NdH_2, (XH_1), SmH_0. Samarium does not combine with hydrogen, and the author concluded that between Nd and Sm there was an element X with the hydride XH_1. There was other chemical evidence. H. N. A.

2530. *The Constitution of the Atoms Sc to Ni.* **R. Samuel** and **E. Markowicz.** (Zeits. f. Physik, 38. 1–2. pp. 22–32, 1926.)—Grimm and Sommerfeld have recently [see Abstract 1520 (1926)] dealt with the connection between the electronic configuration of the atoms and their chemical behaviour, but have directed their investigation more to the properties of the separate groups. For the elements Sc to Ni, Hund, on the basis of spectroscopic data, has put forward proposals on the distribution of the electronic groups which the present authors now treat from the standpoint of the available chemical data. The scheme proposed has been derived from the analogy of the valency system and the paramagnetic behaviour of the ions. With the aid of a few simple assumptions—such as, for example, that the detachment of electrons in the series 4_{11}, 3_{33}, 3_{32} takes place, so that generally two electrons are more intimately coupled—a series of chemical properties has been schematically arranged in qualitative agreement. The electronic arrangement adopted is regarded as affording a close approximation to the chemical behaviour of the elements, and the gap found between Mn and Fe appears to be of consequence. In every case the authors maintain that a distribution of 3_3 electrons into partial sub-groups is necessary, since without such an individualising factor the chemical behaviour can hardly be deduced from the electronic arrangement. The scheme depends on the assumption that the distribution of electrons into sub-groups is constant, and does not alter during absorption and emission processes. H. H. Ho.

2531. *Rotation of the Perihelion of the Orbit of the Light Electron in Atoms of the Hydrogen Type.* **B. Walter.** (Zeits. f. Physik, 38. 1–2. pp. 33–34, 1926.)—In this note it is pointed out that the magnitude, $\Delta\phi$, of the rotation of the perihelion for non-penetrating orbits of the light electron in atoms of the hydrogen type is expressed by the very simple formula $\Delta\phi = 2\pi\frac{C_1}{k^2}$. Here k is the azimuthal quantum number and C_1 is a dimensionless constant characterising the action of the remaining electrons on the light electron. W. S. S.

2532. *Quantum Mechanics of Collision. Preliminary Communication.* **M. Born.** (Zeits. f. Physik, 37. 12. pp. 863–867, 1926.)—A sketch is given of the way in which the problem of the reciprocal action of a free particle and an atomic system may be dealt with by quantum mechanics. Schrödinger's formulation is employed, in which the nth quantum state of an atom corresponds to the oscillation throughout space of a certain "state function" with constant frequency W°/h. The appropriate oscillation for an electron moving in a straight line is a plane wave. The problem now is to solve Schrödinger's wave equation for the combination atom-electron under the condition that the solution in a given direction of the electron space tends asymptotically to a plane wave. The general character of the solution is outlined, and it appears that a qualitative explanation of collision phenomena is obtained. The detailed investigation is to be published shortly. W. S. S.

2533. *A Quantum Theory of Three or More Atomic Molecules.* **F. Lütgemeier.** (Zeits. f. Physik, 38. 4–5. pp. 251–263, 1926.)—On the basis of the old quantum rules the quantising of polyatomic molecules with three principal moments of inertia, all different, is considered. The vibration of the atoms relative to each other and the deformation due to centrifugal forces are neglected. If two of the moments of inertia are nearly equal, two cases arise according as the third is greater or less than the other two. These formulæ include the Schwarzschild formula for the case of a diatomic molecule with two equal moments of inertia. If two moments are not nearly equal, the first formula holds for the initial value of the quantum number and the second formula for subsequent numbers. J. E.

2534. *The Undulatory Mechanics of Schrödinger.* **L. Brillouin.** (Comptes Rendus, 183. pp. 24–26, July 5, and pp. 270–271, July 26, 1926.)—In the first paper the author, in dealing with the position of the fundamental problem of Schrödinger [see Abstract 1512 (1926)], has considered a general method of resolution by successive approximations. He finds that the mechanics of Schrödinger includes the older quantum mechanics as a first approximation, and indicates the simplest case which may be resolved by separation of variables, but concludes that in general supplementary combinations occur between the variables.

In the second paper the author discusses a general type of problem which permits the separation of the variables in the undulatory mechanics of Schrödinger. Both papers are entirely mathematical. H. H. Ho.

2535. *The New Undulatory Mechanics.* **L. de Broglie.** (Comptes Rendus, 183. pp. 272–274, July 26, 1926.)—The recent investigations of Schrödinger [see Abstract 1512 (1926)] have dealt with the undulatory nature of mechanics, and, based on this, the present author derives the equation of propagation of the wave associated with the movement of a material point in a moving field from a consideration of the equation of energy. When Brillouin's approximation, which leads to Jacobi's equation, is not applicable, as in the case of intra-atomic mechanics, the author proceeds to introduce relativity considerations to effect a more general solution—*e.g.*, to treat the case of an electron subjected to an electromagnetic field, the quadridimensional energy-quantity of movement vector p and the universal potential vector ϕ are introduced. The paper is entirely mathematical. H. H. Ho.

2536. *Schrödinger's Undulatory Mechanics.* **V. Fock.** (Zeits. f. Physik, 38. 3. pp. 242–250, 1926.)—A modified form of Schrödinger's wave equation [see Abstract 1612 (1926)] is given, which is applicable whenever the Hamilton-Jacobi equation has the form $H\left(q\frac{\partial W}{\partial q}\right) + \frac{\partial W}{\partial t} = 0$, where $H\left(q\frac{\partial W}{\partial q}\right)$ is a quadratic but not necessarily homogeneous function of the $\frac{\partial W}{\partial q}$s. The method is then applied to the following cases: (1) Keplerian motion in a magnetic field; (2) motion of an electron in the field of a nucleus possessing both electric charge and magnetic moment; (3) relativistic Kepler motion; (4) Stark-effect. The results for some of these examples have already been given by Schrödinger, but in the present paper the working is given in detail. W. S. S.

2537. *Quantisation as a Problem of Characteristic Values, the Perturbation Theory and its Application to the Stark-Effect of the* H *Balmer Lines.* **E. Schrödinger.** (Ann. d. Physik, 80. 5. pp. 437–490, July 13, 1926.)—The author has pointed out in a previous paper that the practically available possibilities for the application of the theory can be considerably extended beyond the "directly soluble" problems, and that approximate solutions can be obtained for problems which are sufficiently near to a directly soluble problem [see Abstracts 2017 and 2024 (1926)]. In analogy with ordinary mechanics such solutions are said to be obtained by the perturbation method; this is essentially the same as that employed by Lord Rayleigh in investigating the vibrations of a string with small inhomogeneities. The theory is worked out mathematically and is applied to the calculation of the intensity of the lines produced by the Stark-effect from the Balmer lines. Tables are given containing the observed and calculated intensities, and these are plotted in a series of diagrams. Although the theoretical and experimental diagrams are not identical, there are strong similarities between them. The author points out that in the theoretical calculations it is necessary to assume that the field employed is in all cases small, while in the actual measurements it is necessary to use strong fields, which no doubt greatly alter the relative intensity of the lines. H. N. A.

2538. *Quantum Mechanics of the Rotator.* **I. Tamm.** (Zeits. f. Physik, 37. 9. pp. 685–698, 1926.)—Born, Heisenberg and Jordan's formulation of quantum mechanics [see Abstract 45 (1926)] applies only to libration coordinates. The present author gives a solution of the case of the simple rotator with the Hamiltonian $H = \frac{1}{2I}p^2$ by first transforming classically the cyclic coordinate q and its moment p to libration coordinates p', q', using the contact transformation generated by $V = p' \sin q$. The transformed Hamiltonian $H'(p'q')$ is then carried over to the matrix form of quantum mechanics and the amplitudes and frequencies evaluated. The formula for the frequencies, $\nu(k, k-1) = \frac{2kh}{8\pi^2 I}$, leads, without further assumptions, to the observed " gap " in the system of equidistant lines, and it is the form which the earlier quantum theory would give on substituting half-quantum numbers. In an appendix the question is discussed whether the matrix forms of two Hamiltonians which are canonically related classically will lead to the same values for the energy or term matrix. W. S. S.

2539. *The Quantification of Rotators and the Choice of Coordinates in the New Quantum Mechanics.* **O. Halpern.** (Zeits. f. Physik, 38. 1–2. pp. 8–11, 1926.)—The Born-Heisenberg-Jordan quantum mechanics in its matrix form refers to systems whose coordinates in classical mechanics are periodic functions of the time. The Hamiltonian function of the new quantum mechanics is thereby so derived that in the classical Hamiltonian function, expressed in cartesian coordinates, the particular matrix is inserted in place of the respective coordinate and impulse. Systems with cyclic coordinates such as rotators fall outside the scope of this method, but if systems of several degrees of freedom are introduced whose kinematic subsidiary conditions are neglected, the cyclic method described in § 1 of the paper can be used for libration notions. § 2 is devoted to a discussion of the choice of coordinates when the integration of quantum problems is attempted generally. The paper is entirely mathematical. H. H. Ho.

2540. *Note on M. Bronstein's Paper : The Relativity Theory of the Motion of an Electron in the Field of a Fixed Positive Charge.* **J. Kudar.** (Zeits. f. Physik, 37. 10–11. pp. 861–862, 1926.)—In the paper referred to [see Abstract 1252 (1926)] M. Bronstein deduces from the principle of the inertia of energy the formula for the variation of the mass of the electron, $m = \left(m_0 - \frac{e^2 Z}{c^2 r}\right) \Big/ \left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}}$, where $-\frac{e^2 Z}{r}$ is the potential energy of the electron in the field of the positive charge. The present author gives a proof that such a modification of the usual formula, $m = m_0 \Big/ \left(1 - \frac{v^2}{c^2}\right)^{\frac{1}{2}}$ cannot be regarded as a deduction from relativity mechanics (non-gravitational), and that therefore the investigations of Bronstein do not rest on a valid application of relativity theory. W. S. S.

2541. *Quantum Theory and Five-Dimensional Relativity Theory.* **O. Klein.** (Zeits. f. Physik, 37. 12. pp. 895–906, 1926.)—Kaluza's theory of electromagnetic and gravitational fields [see Abstract 693 (1922)] is correlated with the form of the quantum theory developed by de Broglie and Schrödinger [see Abstract 1512 (1926)]. Kaluza's theory expresses the ten Einstein gravitational potentials g_{ik} and the four electromagnetic potentials ϕ_i in terms of the coefficients γ_{ik} of the line element in a Riemannian space of five dimensions. The equations of motion of electrical particles in an electromagnetic field then take the form of the equations of the geodesics. These being interpreted as equations referring to the emission of radiation originating in matter, partial differential equations of the second order, which can be regarded as a generalisation of the ordinary equations of wave motion, are derived. Solutions of these equations in which the fifth dimension enters as a pure harmonic component having a period conforming with the value of Planck's constant effect a transition to the form of quantum theory due to Schrödinger. J. S. G. T.

2542. *Relativity Quantum Mechanics with Application to Compton Scattering.* **P. A. M. Dirac.** (Roy. Soc., Proc. 111. pp. 405–423, June 2, 1926.)—Heisenberg's new quantum mechanics [Abstract 45 (1926)] takes its simplest form if one assumes merely that the dynamical variables are numbers, called q-numbers, that obey all the ordinary algebraic laws except the commutative law of multiplication, but satisfy instead the relations $q_r q_s = q_s q_r$, $p_r p_s = p_s p_r$, $q_r p_s - p_s q_r = 0$ $(r \neq s)$ or ih $(r = s)$, where the p's and q's are a set of canonical variables and h is an ordinary number equal to $(2\pi)^{-1}$ times the usual Planck constant. With the aid of these numbers one can build up a complete algebraic theory of quantities that are analytic functions of a set of canonical variables. Then the quantity $[x, y]$ defined by $xy - yx = ih\,[x, y]$ is completely analogous to the Poisson bracket of the classical theory, in so far as it can be expressed in terms of P.B.'s instead of differential coefficients, and may be taken over immediately into the quantum theory. The author has shown [Abstract 1511 (1926)] that the quantum solution of a multiply periodic dynamical system may be effected by the introduction of uniformising variables, and the results can then be interpreted in a way explained in the paper, from which it will be seen that the notion of canonical variables plays a very fundamental part in the theory. Any attempt to extend the domain of the present quantum mechanics must be preceded by the introduction of canonical variables into the corresponding classical theory, with a reformulation of this classical theory with P.B.'s in place of differential equations. The object of the present paper is to obtain in this way the extension of the quantum mechanics to systems for which the Hamiltonian involves the time explicitly and to relativity mechanics.

Theory of Compton Scattering: Consider a free electron subjected to plane-polarised monochromatic incident radiation. The electron and incident radiation together may be considered to form a dynamical system whose emission spectrum can be determined by the new theory, although it is usually called not an emission spectrum but a scattered radiation. Neglecting small quantities, the equations that express the conservation of momentum and energy on Compton's light quantum theory of scattering give the same values for the frequency of the scattered radiation and the recoil momentum of the electron as the present theory. This can be tested by experiment. G. W. DE T.

2543. *Straight-line Relativity in Oblique Coordinates: also Illustrated by a Mechanical Model.* **V. Karapetoff.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 155–182, Aug., 1926.)—It is shown that the fundamental space-time-velocity relations of Einstein's original restricted theory of relativity, when the observed point, line, or ray of light moves in the direction of the observers themselves, can be represented quantitatively and visualised by using two sets of oblique time-space coordinates, forming the Lorentzian plane. For the observer moving in the positive direction at the relative velocity q, the angle between the coordinate axes is 90° − α; for the observer moving in the negative direction the angle is 90° + α, where $\sin \alpha = q/c$; α has been named the velocity angle. The concept of intrinsic coordinates of an event is introduced, and certain simple phenomena are expressed in these coordinates. A spatium is defined as a vector which can be differently resolved into space and time components by different observers. The general method is illustrated by showing graphically the Fitzgerald contraction of a length, the slowing down of a clock, the fact that two velocities always add to one less than that of light, the Doppler-effect, reflection from a moving mirror, etc. A simple mechanical model is described which conveys some of the foregoing relations directly to the eye and which can be used for demonstrations before a large audience. AUTHOR.

2544. *The Variability of Mass in the Problem of Two Bodies.* **J. Kudar.** (Zeits. f. Physik, 38. 1–2. p. 141, 1926.)—The author points out that the conclusion reached by G. v. Gleich that the Einstein expression for the line-element is irreconcilable with the fine-structure of spectral lines [see Abstract 1529 (1926)] is in error and attributable to a confusion between the effects of gravitational and electromagnetic fields. The Einstein line-element refers to the gravitational field only. The gravitational fields of the electron and atomic nucleus are negligible compared with their electrostatic fields, and the Einstein form of line-element cannot therefore be applied to the determination of the perturbation of the motion of the electron. J. S. G. T.

2545. *The Variability of Mass [in the Problem of Two Bodies].* **G. v. Gleich.** (Zeits. f. Physik, 38. 1–2. pp. 142–143, 1926.)—The author dissents from Kudar's conclusion [see preceding Abstract]. J. S. G. T.

2546. *Relation between the Constant of Gravitation and Other Fundamental Constants.* **G. Darrieus.** (Comptes Rendus, 183. pp. 190–191, July 19, 1926.)—It is shown that Décombe's formula, connecting the constant of gravitation with the constants of Avogadro, Faraday, Rydberg and Planck [see Abstract 787 (1925)] may be reduced to the form $g = \frac{2e}{m} \cdot \left(\frac{\alpha m}{m_{\mathrm{H}}}\right)^4$, where $\alpha = \frac{2\pi e^2}{hc} = 7 \cdot 29 \times 10^{-3}$. A. W. L.

METEOROLOGY AND GEO-PHYSICS.

2547. *Meteorological Aerodynamics.* **H. Koschmieder.** (Meteorolog. Zeits. 43. pp. 246–253, July, 1926.)—The velocity potential equation is first applied to show that it can exist only in a homogeneous or adiabatic atmosphere, and also only then if in the undisturbed field the velocity is the same at all heights. The stream-line function is next applied to find the conditions for a current free from vortices. The reduction of pressure to mean sea-level for high-level stations is examined, and the methods used by Anderkó and Exner are discussed and considered wrong. It is considered that for any straight-line current the change of pressure with height is determined solely by vertical distribution of mass. Finally, the statical density distribution is examined, and it is shown that in a dense atmosphere the dynamical pressure distribution obeys the same differential equations which the pressure gradient obeys in an atmosphere without weight. Further, considering statical pressure as a height coordinate, the continuity equation assumes the same form for compressible and incompressible media if the movement is expressed in cartesian coordinates. R. S. R.

2548. *Distribution of Humidity in the Atmosphere.* **W. Khanewsky.** (Meteorolog. Zeits. 43. pp. 253–256, July, 1926.)—From the published aerological soundings on international days, 1905–1912, values have been extracted and annual means calculated for the relative humidity up to 20 km. over Hamburg, Lindenberg, Uccle, Strasburg, Munich and Pavia. Mean values for all six stations are also found, and it is noted that for all parts the relative humidity, *r*, decreases with height. Between the surface and 3 km. the mean decrease is 37 % in winter, 35 % in autumn, 16 % in spring, and 13 % in summer. It was considered possible to separate four zones: (1) Surface – 1 km. where the condensation processes are most frequent; (2) 1–4 km., with condensation processes less frequent, less vapour and smaller temperature gradient; (3) 4–11 km., with a balance between the ordinary decrease of *r* with height and the large temperature decrease, and thus *r* is almost constant; and (4) above 11 km., where temperature begins to rise, but results here do not show an increase of *r*. Hergesell's formula for the change of *r* with height applies only to the second zone. A preliminary survey was made for the variation of *r* with height in different parts of an anticyclone and a depression. For the latter *r* decreases at very different rates in the several quadrants. Finally, absolute humidities are calculated from *r*, and the temperature for five stations, and these values tabulated for all heights up to 10 km. The greatest change occurs from the surface to 2 km., while above 5 km. the change is very slow, as values are so small. A comparison of these results with those calculated from formulæ given by Suring and by Hergesell shows that the former's expression is more accurate. R. S. R.

2549. *Proportions of Krypton and Xenon in the Atmosphere.* **C. Moureu and A. Lepape.** (Comptes Rendus, 183. pp. 171–175, July 19, 1926.)—The authors have re-examined the values found by Ramsay and Travers in 1900, and Ramsay in 1903, for the proportions by volume of Kr and Xe in the air. The gases were separated by fractional distillation and the products tested by a spectrophotometric method. The proportions given by volume are Kr $1 \cdot 0 \times 10^{-6}$ and Xe 9×10^{-8}, results which agree more with the values found by Ramsay and Travers, and they consider errors must have crept into the later measurements. The results are true to 10 %. According to the above figures Aston's results regarding the non-existence of any constituents in the air other than those already found greater in amount than 1 in 10^{15} and probably 2 in 10^{16} parts should be modified to 2 in 10^{14} and probably 1 in 10^{15} parts. R. S. R.

2550. *Periods of Steady Temperature at a Station of Average Height.* **A. Baldit.** (Comptes Rendus, 183. pp. 139–141, July 12, 1926.)—The author has extracted from the temperature records for Puy-en-Velay, situated on the Central Plateau at a height of 684 m., the periods when the temperature variation did not exceed 1° C. in 12 consecutive hours; 301 cases were found for the 16 years 1910–1925, and they are connected with the passage of warm fronts over this station. The following features were noted: (1) The greatest frequency, 65, occurred in January, with a secondary maximum of 56 in November. The best period was 20th to 30th November. (2) The actual temperature was slightly above the mean monthly minimum. (3) 0° C. was most frequent, and to a less extent −4°, 6° and 13°. The two last are connected with the westerly Atlantic current and the southerly Mediterranean current. (4) The most frequent time of occurrence, 11–23 h., contains 274 of the occasions, while 17–18 h. is the hour of arrival which is most frequent, though this varies a little with the hour of sunset. There is a secondary maximum, 12–13 h., probably connected with the maximum cloud amount at this time. (5) Correlating with wind directions, N.W. is most frequent, this occurring with overcast days in summer, and N. or N.E. next, which occurs with overcast days in winter. A secondary maximum for S. winds appears to be a Föhn-effect. R. S. R.

2551. *General Movements of the Atmosphere in West Africa.* **H. Hubert.** (Comptes Rendus, 183. pp. 229–231, July 19, 1926.)—Although the horizontal and vertical components of velocity of the main air currents in this district vary on account of season and daily changes of the sun and the influence of pressure, average values can be obtained. Values for the horizontal and vertical components of velocity and for temperature at different heights on an average day at Dakar at 10 a.m. are given for (1) the dry season for the trade wind (N.N.E.), harmattan (E.) and anti-trade wind (S.W.), and (2) the winter season for the monsoon (S.W. to W.), harmattan (E.) and the upper W. wind. Values for the velocities and temperatures are also given for the boundary regions between these currents. R. S. R.

2552. *Seismology in Canada.* **E. A. Hodgson.** (Roy. Astron. Soc. Canada, J. 20. pp. 158–167, June, 1926. Paper read before the Seismological Soc. of America, Washington, May, 1926.)—This paper deals with the circumstances surrounding the installation of seismographs, at Toronto in 1897, at Victoria in 1898, at Ottawa in 1906, at Halifax and Saskatoon in 1915, and at Ste. Anne de la Pocatiere in 1925. These instruments and those later installed at the first three stations above mentioned, together with one no longer in use at St. Boniface, form the instrumental equipment available. The nature of the locations of these is dealt with and the time services are described. The publications regularly issued are reported and some forthcoming reports announced. The work being undertaken in the province of Quebec is touched on. The paper concludes with a brief outline of the cooperative efforts of the seismological service of Canada in the past, and declares this idea of cooperation to be the outstanding characteristic of the seismological programme now in contemplation. AUTHOR.

2553. *Character of the Maxima on Seismograms.* **E. Rothé.** (Comptes Rendus, 183. pp. 136–139, July 12, 1926.)—From a study of seismograms it is evident that the same earth movement produces at different stations quite different maximum phases and such as to alter the general character of the waves. The author supposes that when a shock occurs in the lithosphere the vibrations produced may be amplified by resonance at the irregular boundary between the sima, or fluid magma, and the lithosphere, while the surface of reparation of the sial and sima can propagate

Rayleigh waves which will interfere with the general train. It is concluded that for the Pacific region most earthquake shocks present a wave with a definite vertical movement, but a speed below that generally given for Rayleigh waves. This wave is followed by other trains of waves interfering with the first, and producing beats often so definite that they can be reproduced artificially. For different trains of waves there are different speeds, which repeat for any one station, but vary from one station to another and from region to region. R. S. R.

2554. *Special Case of Tidal Motion in a Semicircular Basin.* **J. Proudman.** (Roy. Astron. Soc., M.N., Geophys. Suppt. 1. pp. 360–371, June, 1926.)—A semicircular basin is considered whose depth is a function of the distance from the centre of the straight coast, the mathematical problem being similar to that of a basin on a sphere bounded by a complete meridian. The special case taken is for the period of the harmonic motion half the effective period of rotation of the sea, and with the depth of the basin uniform. If the extent of the sea is sufficiently small, and the depth sufficiently great, for the time taken by a tidal wave in crossing to be small compared with the period of the forced tides, the first approximation to these tides will be given by the equilibrium theory. It is shown that under these conditions in the northern hemisphere for free tides the wave progresses round the sea in a positive sense, while for the forced diurnal tides the elevation is everywhere proportional to its equilibrium value. The co-tidal lines and co-range lines are found to be symmetrical with respect to the axis, whether the tides be forced or free, while the axis itself will be a co-tidal line on which, however, the phase of the elevation may suddenly change by 180° on passing through an amphidromic point. R. S. R.

ASTRO-PHYSICS.

2555. *Correlation between Prominences and Solar Filaments. Faculous Disturbance.* **da C. Lobo.** (Comptes Rendus, 183. pp. 188–189, July 19, 1926.)—A spectroheliograph, identical with that at Meudon, has been installed at the Coimbra Observatory near the magnetic apparatus. Registration by the K-line of calcium has already begun, and registration by the H_α-line of hydrogen will begin shortly. The solar activity is compared directly with the movements of the magnetic needle. The author discusses the series of monochromatic solar images on January 25th–26th and on March 9th–15th, which afford evidence that a filament is a prominence seen in projection. He also studies the undulations on the solar limb caused by a facula on March 11th. A. S. D. M.

2556. *Transmission of Radiation through an Absorbing Medium in Motion, with Applications to the Theory of Sunspots and Solar Rotation.* **S. Rosseland.** (Mt. Wilson Observat., Contrib. No. 313. Astrophys. J. 63. pp. 342–367, June, 1926.)—The theory is developed in a general way so as to include cases in which the medium is in motion and the state not stationary in time (§§ 1–5). In §§ 1–4 the properties of the radiation field alone are studied, and in § 5 the equation for the combined flow of material and ethereal energy are given. In § 6 the preceding theory is applied to sunspots. It is assumed that the energy of solar radiation proceeds mostly from the sun's interior, and that in the spots this uniform stream of radiation is modified by convectional currents. This picture of the phenomenon leads to a simple formula connecting the mean density, mean vertical velocity, and mean vertical thickness of a spot. The theory leads to values of the thickness and velocities corresponding to the observed reduction of temperature in spots which are reasonable, but lack of observations prevents a more rigorous test. In the last section the theory of solar rotation is discussed. It is emphasised that the equatorial acceleration of the sun may be intimately connected with the manner in which the energy of solar radiation is generated, and that pre-existing theories of the evolution of rotating stars need revision in order to take account of internal motions other than a rigid rotation. Friction being neglected, it is shown by a simple example how the source of energy determines the variation of angular velocity parallel to the axis of rotation, the variation perpendicular to this direction remaining undetermined to this degree of approximation. AUTHOR.

2557. *The Perihelion Question.* **G. v. Gleich.** (Zeits. f. Physik, 38. 4–5. pp. 353–358, 1926.)—The author points out that the amount of the perihelion perturbation is by no means absolutely settled, owing perhaps to the defects of the methods employed. On the basis of Stockwell's figures (1870) the theoretical perturbation is increased by $15''$, so that with Grossmann's discussion of observations and the kinetic mass theory the discrepancy hitherto existing may be eliminated without a remainder. [See Abstract 705 (1926).] E. F.

2558. *K-Term, Relativity Displacements, and Convection Currents in B-Type Stars.* **S. Albrecht.** (Astrophys. J. 63. pp. 277–280, June, 1926.)—An analysis is made of the various factors contributing to the K-term of + 4·0 km. in B-type stars. Systematic errors in the normal wave-lengths employed in the computations would change the radial velocities by about − 1·4 km./sec., thus reducing the K-term to about + 2·6 km. In order that relativity displacements might be as great as + 2·6 km. it would be necessary that the average mass of B-type stars be about 25 $\odot$ with a density of 0·1, or about 10 $\odot$ with a density of about 0·6. Although either of these alternatives is possible, the most probable amount of the relativity shift, based on the generally accepted values for average mass and density, is + 1·4 km., in terms of velocity. General downward convection currents may be the cause for the remaining + 1·2 km. of the K-term, with about + 2·0 km. as an upper limit and zero as a lower limit for this effect. AUTHOR.

2559. *Orbit of the Spectroscopic Binary* 19 τ^5 *Eridani.* **O. Struve.** (Astrophys. J. 63. pp. 368–371, June, 1926.)—The orbital elements of this spectroscopic binary with double lines were derived from forty spectrograms obtained with the one-prism Bruce spectrograph of the Yerkes Observatory. $P = 6^d2236$; $\gamma = +15\cdot0$ km./sec. ; $e = 0\cdot20$; $K_1 = 107$ km./sec. ; $K_2 = 103$ km./sec. ; $\omega = 313°$; T = 1925 Oct. 23·05 G.C.T. ; $a_1 \sin i = 8{,}640{,}000$ km. ; $a_2 \sin i = 8{,}970{,}000$ km. ; $m_2 \sin^3 i = 2\cdot87\,\odot$; $m_1 \sin^3 i = 2\cdot76\,\odot$; $m_1/m_2 = 0\cdot96$. AUTHOR.

LIGHT.

2560. *Colour Changes in Barium Platinocyanide under the Action of X-Rays and Heat.* **A. Trapesnikow.** (Zeits. f. Physik, 37. 10–11. pp. 844–858, 1926.)—An account is given of a spectrometric examination of the colour changes taking place when $BaPt(CN)_4 + 4H_2O$ is exposed to X-rays and to heat for varying periods. A. B. W.

2561. *Additive Colouring of Crystals of Alkali Halides.* **Z. Gyulai.** (Zeits. f. Physik, 37. 12. pp. 889–894, 1926.)—The tests previously applied to NaCl have been extended to other alkali halides by heating the crystals in contact with Na or K in a sealed hard-glass tube to a dull-red heat for 5–60 minutes. It is shown that synthetically obtained crystals can be coloured additively. Absorption spectra are obtained for these crystals, and the results agree with those of other experimenters using X-ray methods. It is further stated that an absorption by coarser colloidal particles as a disturbing co-existing phenomena is not to be avoided. [See also Abstracts 867, 876 and 882 (1924).] R. S. R.

2562. *Places of Minimum Regular Reflection.* **K. Pfannenberg.** (Zeits. f. Physik, 37. 10–11. pp. 758–772, 1926.)—The intensity of the reflected light increases mostly with the angle of incidence, but for substances where the refractive index $n > 3 \cdot 732$ a strongly expressed minimum occurs at an angle of incidence independent of n. As such high values for n do not usually occur in the visible spectrum, electric waves were used. Detailed particulars are given of the transmitter and receiver used, each being placed at the focus of a concave mirror. A water surface was first tested and the reflection coefficients obtained for linear polarised radiation for the vectors parallel and perpendicular to the plane of incidence. In this case with $n = 8 \cdot 964$ the minimum of regular reflection occurred with an angle of incidence of 83°, while at 0° the reflection coefficient was 0·64, results which agree well with theory. Further, theoretical considerations indicate that if $n > 8 \cdot 964$ the angle of incidence for minimum reflection should be displaced towards 90° and *vice versa.* This was tested by using aqueous solutions of NaCl with concentrations of 3, 10 and 30 %, and the respective angles of incidence for minimum displacement were 82°, 82° and 80°, while there was a progressive decrease in the fraction of light reflected for the angle of incidence zero. Further tests on sheet metal and asphalt confirmed the results obtained with the solutions. R. S. R.

2563. *Retinal Sensibility to Saturation Differences.* **L. A. Jones** and **E. M. Lowry.** (Eastman Kodak Co., Research Lab., Comm. No. 254. Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 25–34, July, 1926.)—Of the three attributes of colour, brilliance, hue and saturation, the latter has probably been accorded the least attention. As defined by the Colorimetry Committee of the Optical Society of America, saturation is that attribute of all colours possessing a hue which determines their degree of difference from a grey of the same brilliance. Since saturation is of a subjective nature it is incapable of direct measurement, but may be evaluated indirectly in terms of purity. The Colorimetry Committee has defined the purity of any sample of radiant energy, with respect to any one of its constituents, as the ratio of this constituent to the total intensity of the sample. For the purpose of this investigation purity will be determined by the ratio of the homogeneous constituent (spectral component) to the total intensity of the sample. So far as the authors are aware, the only experimental work, on the sensibility of the eye for saturation differences, to be found in the literature is that of Aubert 1865, Munsell 1909, Geissler 1913 and Nutting and Jones 1916. The first of these investigators employed rotating discs and determined the smallest sector of colour which produced a just apparent saturation difference against a white or neutral grey background. Aubert found the stimulus increment necessary to be less than 1 %, while Geissler reported a nearly constant value of 4 % for red, green and blue. Nutting and Jones, using a different method, constructed a saturation scale containing about twenty steps. The combined existing data are at best very meagre and offer almost no idea as to the probable shape of the function for the normal human eye. In view of this condition the present work was undertaken for the purpose of securing specific data as to the number of least perceptible saturation steps between each maximally saturated colour and white. Authors.

2564. *The Zeiss-Löwe Liquid Interferometer.* **W. Barth.** (Zeits. Wiss. Phot. 24. pp. 145–158, June, 1926.)—Details of the apparatus have been given previously [see Abstract 243 (1911)]. In the present case a difference method is used, the two media being contained in glass vessels with parallel sides, and the displacement of the interference fringes is used as a measure of the difference of the refractive indices of the contents of the two vessels. The displacement produced by the liquid tested is compensated by rotating in the path of the light a glass plate employing a micrometer screw for the purpose. The plate is rotated, if white light is used, until a sudden change occurs in the colouring of the edge of the fringes. The change is due to differences in the dispersion of the standard and the investigated liquids and of the compensating plate. The variation of refractive index with the scale divisions of the screw is examined, and an expression evaluated to connect these. R. S. R.

2565. *Investigation of Very Dilute Solutions.* **W. Barth.** (Zeits. Wiss. Phot. 24. pp. 158–166, June, 1926.)—The method described [see preceding Abstract] is used to determine the variation of refractive index with concentration for aqueous solutions of KCl, $MgSO_4$, $Hg(CN)_2$ and urea. Much more dilute solutions are used than those tested by earlier experimenters, and rapid working is possible. The maximum error probable in the results due to temperature change, titration of the solutions and evaporation is 0·3 %. For non-electrolytes a straight-line relation connects the concentration with the rotation of the compensating plate, while for electrolytes the curve is concave to the concentration axis as it approaches the null point. Further observations are required to establish this difference. R. S. R.

2566. *Tracing the Progress of Chemical Reactions with the Zeiss-Löwe Liquid Interferometer.* **K. Schaum** and **W. Barth.** (Zeits. Wiss. Phot. 24. pp. 166–171, June, 1926.)—Using the relation, established in the earlier paper [see Abstract 2564 (1926)], that concentration c is proportional to reduced scale divisions σ, one may substitute the quantity σ for c in the equations of the laws of mass action which govern the progress of chemical reactions. By observations of the change of σ with time the progress of the chemical changes can be examined. Useful readings cannot begin for 1–3 minutes owing to temperature differences in the liquids mixed and to the temperature effects of dilution and mixing. Great care to avoid losses by evaporation is needed for reactions taking place slowly, and difficulties also arise from unavoidable temperature changes. On the other hand, rapid changes introduce large errors in measurement. Examples are given of the application of the method. R. S. R.

2567. *The Eyepiece Interferometer and the Objective Interferometer for the Resolution of Double Stars.* **V. Ronchi.** (Zeits. f. Physik, 37. 10–11. pp. 732–757, 1926.)—A general explanation is first given of the behaviour of a circular grating. Consideration is next given to the diffraction pattern produced by a linear grating placed in the path of a spherical wave of light coming from a distant star, and this theory is developed to cover the case for a circular grating. It is shown that with this arrangement a picture of a light source is obtained, which, though less bright than that produced by an ordinary lens, is entirely free from spherical aberration and is achromatic, thus possessing a greater purity than the other picture. The ultimate resolving power of the different arrangements for double stars is then examined, and it is shown that the circular grating can separate the double stars equally as well as an objective of 2·44 times as great a diameter. The diffraction grating separates the stars in two ways: (1) as an objective in so far as it produces a picture, and (2) as an interferometer, for it allows a measurement being made of the angular distance by observation of the bands. Thus the name "eyepiece interferometer" is used since the circular grating replaces an eyepiece, and the name "objective interferometer" since it assumes the *rôle* of the objective. R. S. R.

2568. *Distribution of Intensity in an Astigmatic Beam as Depending on the Distance between the Focal Lines and the Size of the Opening.* **J. Picht.** (Ann. d. Physik, 80. 5. pp. 491–508, July 13, 1926.)—The calculations are based on the wave theory of light, and are carried out with the help of the equation obtained by the author previously [see Abstract 267 (1926)]. Tables are given containing the calculated intensities at various points within the beam, and these are plotted in a number of curves which show the peculiarities of the intensity distribution. H. N. A.

2569. *Use of the Concave Grating in an Astigmatic Mounting.* **M. Petersen.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 229–230, Aug., 1926.)—An arrangement is proposed whereby overlapping orders may be distinguished, using a simple quartz lense to project the image of the source on the slit of the spectrograph. AUTHOR.

2570. *Standard Wave-Lengths for Use in the Extreme Ultra-Violet.* **S. Smith and R. J. Lang.** (Phys. Rev. 28. pp. 36–45, July, 1926.)—Wavelengths of a number of lines, chiefly of carbon, which frequently occur in the spectra of other elements have been measured in the second and third orders on plates obtained in a vacuum spectrograph with a concave grating with a radius of 6 ft. ruled with 30,000 lines to the inch. The dispersion was approximately 4·5 Å. per mm. The carbon lines and the iron standard lines used as comparisons were obtained simultaneously by passing a condensed spark discharge between a carbon and an iron electrode. Details are given of a new method of obtaining curves to correct for (*a*) deviation of the spectra from normality, (*b*) error in the tilt of the photographic plate. These curves can be used for correcting the calculated wave-lengths obtained by interpolation between any pair of standards chosen within the range of the curves. [See also Abstract 2069 (1926).] AUTHORS.

2571. *New Large Mirror Spectrometer for Grating Measurements in the Long-Wave Spectrum.* **C. Leiss.** (Zeits. f. Physik, 37. 9. pp. 681–684, 1926.)—Description of an ultra-red spectrometer on the principle of Rubens, intended specially for measurements exceeding 300μ with the aid of large gratings in conjunction with concave mirrors of high reflecting power. The construction of the apparatus is shown in two illustrations essential to the description, but not suitable for reproduction in a short abstract. E. F.

• **2572.** *Apparent Brightness of the Face of Emergence of an Optical System consisting of Any Number of Thick Lenses.* **A. Blondel** and **A. Dargenton.** (Comptes Rendus, 182. pp. 1443–1447, June 14, 1926.)—Formulæ are obtained showing the intrinsic brightness of the image after transmission through any stigmatic system. Absorption and loss by reflection are neglected. The numerical results are given for the case of a point source at the focal point of a thick lens, only the axial beam being considered. A. A. D.

2573. *The Eyepiece Micro-Pyrometer.* **A. Goetz.** (Zeits. f. Physik, 38. 1–2. pp. 119–123, 1926. Paper read before the Deut. Phys. Gesell., Brunswick, Feb., 1926.)—A special inexpensive form of microscope eyepiece is combined with a microscope objective to obtain measurements of the temperature of very small glowing bodies. The microscope objective forms an image of the filament to be tested superposed on the filament of a standard lamp inserted between the eyepiece and the objective. By adjustment of the current in the standard lamp the brightnesses of the filaments can be equalised. The filaments can be viewed through a Schott red filter or through smoked glass of two different degrees of transparency. From the measurement of the current in the standard lamp its temperature can be calculated, and will be that of the filament examined. Temperatures up to 3000° C. can be determined with an accuracy of ± 2° at 1000° C. and ± 10° at 2000° C.

R. S. R.

2574. *Use of Vector Methods for the Calculations of Optical Systems.* **E. Madelung** and **B. Gündel.** (Zeits. f. Physik, 38. 1–2. pp. 124–128, 1926.)—A number of examples are given of calculations for the passage of light through plane and spherical refracting surfaces. Besides forming an illustration of vector methods, the authors consider that in some cases they are less cumbersome than other methods. R. S. R.

2575. *The Distribution of Light in Elementary Optical Images.* **L. C. Martin.** (Optical Soc., Trans. 27. 4. pp. 249–263; Disc., 263–264, 1925–1926.)—The paper presents the results of a series of calculations on the distribution of light near the "star focus" of a centred lens system in the following cases: (*a*) Freedom from aberration; (*b*) primary spherical aberration; (*c*) zonal spherical aberration. In the two latter cases the condition chosen is that when the least residual phase differences amount to $\pi/2$. The characteristic extra-focal effects are determined, and the effect of primary spherical aberration on resolving power is discussed. In the case of zonal aberration the greatest axial intensity is not found at the focus giving least phase residuals. In both cases of aberration a concentration closely resembling in some respects the "Airy" disc characteristic of zero aberration is found. These results are an extension of those previously obtained by Conrady and Buxton. AUTHOR.

2576. *Note on Chalmers' Applications of the Hartmann Test.* **T. Smith.** (Optical Soc., Trans. 27. 4. pp. 242–248, 1925–1926.)—Attention is called to Chalmers' applications of the Hartmann test in 1904 to the determination of all relevant aberrations of photographic lenses. It is shown that the theory of these tests, whether with the photographic plates normal to the lens axis or normal to the chief ray, is readily constructed with the aid of the characteristic function. The limitations to and generalisations of Conrady's observation that rays from an axially centred circular zone have their secondary foci on a straight line are discussed. The method of testing lenses by means of interference fringes produced by two or more small apertures is claimed to have originated with Chalmers, whose description anticipated Michelson's by six years. AUTHOR.

2577. *The Blurring of Photographic Images due to Spherical Aberration.* **J. Flügge.** (Zeits. Instrumentenk. 46. pp. 333–354, July, and pp. 389–415, Aug., 1926.)—Points out that the formulæ for the best correction and the best adjustment of the focus given by a number of different authors are by no means identical, and introduces new numerical constants. A number of special photographic aplanatic objectives were constructed and tested, seven with the crown glass lenses outside and eight with the flint glass lenses in this position. The boundary zone aberrations of the lenses in each set were evenly graduated stepwise, and they were employed in the determination of the best conditions of focussing and a general investigation of the problem. The observations were carried out with approximately monochromatic light with wave-length about 493 $m\mu$, produced by means of a specially constructed filter. The paper contains a description of the apparatus employed. It was found that a considerable amount of margin is allowable in the focussing. H. N. A.

2578. *Influence of the Illumination Factor of Theodolite and Level Telescopes on the Mean Error.* **A. Pelzer.** (Zeits. Instrumentenk. 46. pp. 354–376, July, 1926.)—A number of different formulæ have been proposed for recording the property of a telescope, which enables it to give a bright image of the object observed. This depends upon the diameters of the objective (entrance pupil), the exit pupil of the telescope and the pupil of the eye, on the magnification and on reflection and absorption of the light by the lenses. Instead of dealing with "brightness," the estimation of which depends on physiological processes, the author compares illuminations, and his *Lichtstärke*, the ratio between the illumination of the surface of the retina in the image as observed by the telescope and its illumination in the image as observed directly, may be called the illumination factor of the telescope. He has determined this factor by means of a photometric method for a number of different telescopes, and studied the relation between it and the mean error of each of these telescopes when employed in surveying work; there appears to be a distinct connection between the two.

H. N. A.

2579. *Classification of Instruments used in Phototachymetry.* **P. Werkmeister.** (Zeits. Instrumentenk. 46. pp. 376–377, July, 1926.)—Gives a general account of the instruments used in photographic surveying, which are classified into those in which the photographic instrument is mounted on a stand, and those used in flying machines, which are held in the hand. There are also single-plate and double-plate instruments for converting the resulting photographs into ordinary maps; the double-plate instruments represent the country photographed, both as to positions and heights. H. N. A.

2580. *Use of Babinet Compensator.* **J. Ellerbroek** and **J. T. Groosmuller.** (Phys. Zeits. 27. pp. 468–471, July 15, 1926.)—Describes a new method of using the compensator for the analysis of elliptically polarised light. The phase difference is determined by adjusting the telescope on the image of the slit of the compensator. The analyser is then turned, and the movable wedge adjusted until a black band appears in the middle of the slit image. By careful use it is possible to detect a shift of the dark band as small as 0·01 mm., and this corresponds with a phase difference of 0·003 λ. When the phase difference has thus been determined, the telescope is adjusted to the image of the collimator slit, and the analyser is turned until the collimator lines are in the middle of this slit image. Measurements can be made by this method to an accuracy of 2′ in azimuth. J. W. T. W.

2581. *Variation of Rotatory Power of Solutions of Salts of Quinine as a Function of their Hydrogen-ion Concentration. Rotatory Power of Asparagin and Effect of Salt.* **(Miss) J. Liquier.** (Comptes Rendus, 183. pp. 195–198, July 19, 1926.)—The curve showing the rotatory power as a function of the hydrogen-ion concentration shows two flats, corresponding to the basic and neutral sulphates of quinine. The dissociation constants deduced from these curves are about 2×10^{-6} and $1 \cdot 8 \times 10^{-10}$, and agree with values measured directly by Kolthoff. A similar study was made of the influence of neutral salts (*e.g.* KCl) on the rotatory power of asparagin in solutions of different hydrogen-ion concentration. T. M. L.

2582. *Tartrates of Pyridine and of Quinoline.* **Pariselle.** (Comptes Rendus, 183. pp. 210–211, July 19, 1926.)—The curves showing the rotatory power of tartaric acid on progressive neutralisation by a strong base are straight lines running directly from the value for the free acid to that for the salts. The rotatory dispersion gives an arc of a rectangular hyperbole running from 1·19 for the ratio violet/yellow for the free acid to 1·79 for the neutral salts. Since no abnormality appears at the composition of the acid "bitartrates," it is concluded that these compounds do not exist in solution, and that an incompletely neutralised solution contains only bivalent tartrate ions and non-dissociated molecules. An explanation is thus provided of the equal heats of neutralisation of the two acidic functions. The rotatory power of mixtures of tartaric acid and pyridine gives a curve which bends sharply at a ratio of two molecules of pyridine to one of acid ($\alpha = 6 \cdot 7$), rises to a maximum ($\alpha = 7 \cdot 3$) at 5 % pyridine (*i.e.* approximately the composition of the constant-boiling mixture), then falls slowly, and after a sharp bend finishes up at the rotatory power $\alpha = 3 \cdot 5$ of a solution of tartaric acid in pure pyridine. The rotatory dispersion, however, gives a curve like that for the alkalis, running from 1·19 to 1·79, and only falling again at concentrations above 65 % towards the value in the anhydrous solvent. The conclusion is drawn that only the neutral tartrate exists in solution and that it is completely dissociated (ionised ?) in aqueous solutions except at high concentrations of pyridine. On the other hand, only the acid tartrate could be isolated as a soluble crystalline salt melting at 150°, which behaves in solution as a mixture of tartaric acid and the neutral tartrate. Since quinoline is only partially mixable with water, complete curves could not be plotted, but the value of the rotatory power for the neutral tartrate $\alpha = 5 \cdot 5$ shows that the salt is not completely dissociated (ionised ?) in aqueous solution, whilst the final value $\alpha = -1 \cdot 7^\circ$ shows that this tartrate becomes lævorotatory in solution in quinoline. The acid tartrate is, however, the only salt that can be isolated ; it separates in crystals and melts at 122°. **T. M. L.**

2583. *Optical Rotatory Power and Configuration. Part III.* **G. W. Clough.** (Chem. Soc., J. pp. 1674–1676, July, 1926.)—From a study of the rotatory dispersions the conclusion is drawn that dextrorotatory chloro- and bromo-succinic acids have the same configuration as the "*l*" amino- and hydroxy-acids. **T. M. L.**

2584. *Rotatory Magnetic Dispersion and Dispersion in Electric Double Refraction.* **R. de Mallemann.** (Comptes Rendus, 183. pp. 33–35, July 5, 1926.)—In a previous paper the author has deduced an expression for Verdet's constant from molecular theory, and he now states that the ratio between the rotatory magnetic dispersion and that of the electric double refraction should be equal to the corresponding ratio of the wavelengths. This is verified for carbon bisulphide and for camphor dissolved in hexane. **H. N. A.**

2585. *Radiation Diagram of Smaller Dielectric Globes.* **H. Blumer.** (Zeits. f. Physik, 38. 4–5. pp. 304–328, 1926.)—Calculation of dispersion of light at dielectric globes is here substantially extended on the basis of the exact theory of Mie [see Abstract 594 (1908)]. Exact calculations are carried out for globe diameters up to $2\rho = 3 \cdot 8\lambda$ from the index of refraction, m = very small up to $m' = \infty$. The paper, which is of a mathematical nature, is illustrated with diagrams and contains a large number of tables. **A. E. G.**

2586. *Nature of Optical Sensitising. Part II.* **G. Kögel and A. Steigmann.** (Zeits. Wiss. Phot. 24. pp. 171–176, June, 1926.)—According to the authors' theory of optical sensitising in Part I [see Abstract 1306 (1926)], the illuminated colouring matter (in the case of sensitive dyes) activates the hydrogen atom of the gelatine. A part of this active hydrogen it uses itself, but the greater part is given, it is supposed, to the silver halide (in silver salt sensitised plates, etc.). Experimental evidence for the last statement is found in the behaviour of the leukobases, *e.g.* leukorkodamin 69. The pure white leukobase is not sensitised alone, but only when containing rhodamin 69. If the dye alone were the hydrogen acceptor a visible reaction of the leukobase under light would not occur. Applying the theory to carbon assimilation by plants through the agency of chlorophyll, the authors suggest the following reactions: (1) Chlorophyll (light activated) + H_2O (from air) = chlorophyll (inactive) + 2H (active) + H_2O_2; (2) chlorophyll + absorbed H_2CO_3 + 2H (active) = + H_2O_2; (3) $2H_2O_2 = 2H_2O + O$. J. E.

2587. *Primary Action of Photochemical Adsorption.* **G. Kögel.** (Zeits. Wiss. Phot. 24. pp. 216–218, Aug., 1926.)—Experiments showed that while nitrobenzene was not sensitive to light, *o*-nitrobenzaldehyde was a very light sensitive material in comparison. *O*-nitrobenzaldehyde yielded *o*-nitrobenzoic acid quantitatively under the action of light. *O*-nitrocinnamic aldehyde was insensitive to light, pointing to the conclusion that the aldehyde group was not the active cause of the change, and was found to be neither chemically nor photochemically specific in its influence on the course of the reactions. The nitro group appeared to be sensitive to light in many other substances, and the sensitiveness to light was ascribed to the nitrogen, which is joined to two atoms of oxygen. Nitrogen in the groupings $-\underset{\cdot}{N} \equiv N$, $R-N=N-R'$, $-\underset{\diagdown O \diagup}{N-N}-$, $=NH-$, $=NO$, or $-NO_2$ were found to be always sensitive to light. F. J. B.

2588. *Nature of Optical Sensitising and Desensitising.* **H. H. Schmidt.** (Zeits. Wiss. Phot. 24. pp. 223–228, Aug., 1926.)—A criticism of the theory of Kögel and Steigmann [see Abstract 1306 (1926)]. The basis of the theory is in contradiction with the modern ideas of the mechanism of the light effect on silver halide, and with the experimental data on the velocity of bleaching of sensitisers and desensitisers. In the writer's opinion the sensitising of a dye-stuff in water or gelatine by silver halides is effected by the energy taken up as quanta by the halide from the light energy and given up again. This process has an analogy in the dissociation of the hydrogen molecule by mercury atoms excited by U.V. J. E.

2589. *Output of Visible Light in the Excitation of Phosphors by Slow Kathode Rays.* **W. Kordatzki, A. Schleede** and **F. Schroeter.** (Phys. Zeits. 27. pp. 392–401, June 15, 1926.)—A determination of the "economy" of the light production of phosphors. Three types of economy are defined and determined: (1) Energy economy—the ratio of the visible radiation energy to the total energy; (2) photometric economy—ratio of brightness of surface to total energy supplied as radiation; (3) technical economy—ratio of brightness to total energy supplied.

After describing and criticising the methods adopted by Ebert and Lenard [see Abstract 2958 (1904)], the authors proceed to describe their own arrangement. The kathode was an oxide-coated filament, and a very high vacuum was obtained by the usual methods. Simultaneous measurements were made of the electrical energy impinging on the sample and of its brightness. Tables of results are given for $Zn_2S_2O_4 - Mn$, $MgS - Ce$, and SrS — CaS — Bi, and, finally, a comparison of the economy of these with several electric lamps. J. E.

2590. *Experiments on Photographic Inversion.* **H. Belliot.** (Comptes Rendus, 182. pp. 1609–1612, June 28, 1926).—In order to define the photographic properties of red and infra-red radiations, and to compare them with solarisation, highly sensitive photographic plates free from sensitisor were subjected to the action of a portion of the continuous spectrum of the positive crater of the carbon arc given by an optical glass spectrograph. A fogged plate, inverted by rays of wave-length above 0·71 μ, is found to have become again sensitive to white light, whereas this is not the case with the same plate which has been solarised; such regeneration is, however, only partial. The rays which invert a fogged plate act also on a virgin plate, provided that the exposure is sufficient (thirty minutes). T. H. P.

2591. *Experiments on Photographic Solarisation.* **H. Belliot.** (Comptes Rendus, 183. pp. 203–205, July 19, 1926.)—A second distinction between solarisation and inversion by red rays [see preceding Abstract] is now established, it being shown that solarisation is accompanied by direct blackening by light. Experiments show that the blackening produced by normal exposures has maximum values for two neighbouring but distinct wave-lengths, the former being greater than the latter. T. H. P.

2592. *Behaviour of Hydrogen Iodide in the Light from a Quartz Lamp.* **M. Trautz** and **B. Scheifele.** (Zeits. Wiss. Phot. 24. pp. 177–216, Aug., 1926.)—The decomposition of hydrogen iodide when exposed to the light from a quartz lamp was investigated, and the effect of concentration, temperature and other factors, such as distance from lamp, and other sources of light were followed. The results showed that the decomposition of HI gas could be measured by the change of pressure. The decomposition in light and recombination in the dark were not observed. The equilibrium in light was at complete decomposition. The active light rays were those having a wave-length between 300 and 220. An ordinary glass screen reduced the decomposition to zero. Screens of hydrogen, water, or a 10 % solution of copper sulphate did not interfere with the decomposition. The addition of nitrogen did not influence the reaction. The reaction velocity of the decomposition is constant at the beginning, and follows the monomolecular law, with a constant of about 10^{-4} sec.$^{-1}$. F. J. B.

2593. *The Projection and Reproduction of Reticulated Photographs.* **R. Berthon.** (Comptes Rendus, 183. pp. 280–282, July 26, 1926.)—Reproductions of the most brilliant coloured photographs obtained with coloured microscopic elements appear dull. This is also true for Lumière and Agfa plates, for those of Paget and Dufay and for films with microscopic refracting elements producing a virtually coloured network. This is due to the optical superposition of two networks, which do not coincide rigorously point by point, the selecting network of the original photograph, and that of the reproduction. The author describes a method by means of which a trichrome network consisting of parallel lines can be projected on a screen so as to give the colours of the picture without showing any

parallel lines, giving the effect of an ordinary water colour. Two small angle prisms are placed in front of the projecting lens, each of them covering one-third of its surface, so that three different images are projected, shifted with respect to one another by the width of one of the parallel lines. If instead of the screen a suitable photographic plate is employed, a perfectly coloured reproduction of the original is produced.
H. N. A.

2594. *Construction of the Thermo-Photometer II for Meteorological, Botanical and Light-Therapeutic Purposes.* **J. Plotnikow.** (Zeits. techn. Physik, 7. 7. pp. 356–357, 1926.)—In this new form of the author's thermophotometer [see Abstracts 1763 (1924) and 82 (1926)], the gas-receiving vessel is adjustable to either a vertical or a horizontal position. T. H. P.

2595. *A New Photoelectric Photometer.* **H. Goldschmidt.** (Meteorolog. Zeits. 43. pp. 241–246, July, 1926.)—Details are given of the construction and use of the photoelectric cell. Measurements are obtained by connecting it to an electrometer, after excitation, and observing through a microscope the rate of loss of charge on the electrometer. Three filters—red, green and blue-violet—were used at first to limit the spectral range tested, but later a direct-vision spectroscope was employed. The spectrum was divided into five zones with wave-lengths at 700, 580, 500, 450, 420 and 400$\mu\mu$, and the intensity of radiation in each zone could be measured in 5–20 minutes. The arrangement is considered very suitable for finding the spectral distribution of solar energy. It is claimed for the cell that it is free from inertia, constant, very sensitive and simple to operate, while if a more sensitive cell is used, and the intensity of radiation is strong, it can be used as a recording instrument. R. S. R.

2596. *Polarised and Unpolarised Phosphorescence of Solid Dye-stuff Solutions.* **P. Pringsheim** and **S. J. Wawilow.** (Zeits. f. Physik, 37. 10–11. pp. 705–713, 1926.)—Dye-stuffs in solid solutions, in addition to the fluorescence bands of their liquid solutions, always show in the long-wave region other emission bands which, relatively weak in the fluorescence, become more prominent in the after-glow, and are alone present in the phosphorescence at − 180°. These "phosphorescence bands" are, in contradistinction to the "fluorescence bands," completely unpolarised during excitation and in the after-glow. Owing to superposition of the two kinds of bands, the degree of polarisation for the total emission and for the different regions of the spectrum may vary very greatly according to the predominance of one or the other kind. With this assumption all observations made with solid solutions of different dye-stuffs in sugar and gelatine (fluoresceine, eosine, æsculine, rhodaline, rhodamine, tetraiodofluoresceine, scarlet) admit of a uniform interpretation. Several figures and tables are given. [See Abstract 1319 (1926).] E. F.

2597. *The Band Fluorescence of Potassium and Sodium.* **P. Pringsheim.** (Zeits. f. Physik, 38. 3. pp. 161–175, 1926.)—The band fluorescence spectra in vapours of K, Na and K-Na mixtures excited by white light are observed and measured. The vapour mixture shows a new group of bands which have already been observed in absorption and in the luminous arc. The resonance spectra engendered by monochromatic light in this group show a greater distance between the lines than the resonance spectra in the green and red band groups of pure Na. The Na bands are not the result of organic impurities, as they occur also when Na is obtained by heating Na-azide *in vacuo* and electrolysed through the glass. They appear, therefore, to be due to polyatomic molecules of the alkaline metals. Several tables and figures are given. [See Abstract 1790 (1908).] E. F.

2598. *Luminous Emission on Decomposition of Chlorazide.* **K. Gleu.** (Zeits. f. Physik, 38. 3. pp. 176–201, 1926,)—At a pressure of 2 mm. of mercury chlorazide decomposes with a red light into nitrogen and chlorine: $2N_3Cl = 3N_2 + Cl_2$, when the gas is allowed to flow from a capillary to a larger tube heated to 400°. The spectrum of this light shows in the red a band system of four groups not hitherto observed. The red edge of the two groups of medium intensity lies at 6668 or 6283 Å. This system is probably due to a molecule of nitrogen and chlorine atoms. The luminosity of decomposition emits an intense ultra-violet radiation which excites the reaction tube to strong blue or violet fluorescence. The spectrum in the ultra-violet is identical with the continuous chlorine spectrum first discovered by v. Angerer with the two principal maxima at 3060 and 3070 Å. In the light generated by chlorine dioxide decomposition, which may be similarly produced, this continuous spectrum does not appear. Hydrogen, or, better still, hydrazoic acid added to the chlorazide, produces a very intense pure white light, the visible spectrum of which is identical with Eder's α-band of ammonia. The intense ultra-violet spectrum shows a characteristic extension of the ammonia spectrum in this region. In addition to the chief bands with two central maxima at 3360 and 3370 Å., the only ones hitherto known, there occurs a longer wave-band of analogous structure with corresponding maxima at 3742 and 3752 Å. The relation between these two bands appears to be similar to that between the two (C + H) bands at 4315 and 3890 Å. Adjoining the short-wave end of each is an equally intense but differently constructed band. These consist of a relatively small number of rather widely separated lines ending on the short-wave side in a sharp edge at 3240 or 3610 Å., and also due to a (N + H) molecule. Whether a further band shading off towards the red with two chief edges at 3022 and 3040 Å. belongs to this system has not been determined. In no case were bands of the nitrogen molecule observed. Several figures are given. E. F.

2599. *The Luminescence of Water and Organic Substances acted on by γ-Radiation.* **L. Mallet.** (Comptes Rendus, 183. pp. 274–275, July 26, 1926.)—Water exposed about fifteen minutes to radiation from radium (30 mg.) filtered through platinum, so that about 13 % are soft and 81 % are hard γ-rays, gives white luminescence which has its maximum in the vicinity of the radioactive focus. When the layer of water is only a few millimetres thick the phenomenon is less intense, but increases with the thickness up to 8 or 10 cm., in accord with the addition of luminescence effects in successive water layers, which strongly absorb γ-radiation but absorb relatively little of luminous radiation. The various phenomena have been established by photographic control, details of which are included. The emitted radiation has been analysed by means of various screens and shown to contain ultra-violet radiation of wave-length less than 3000 Å. Transparent ice exposed to γ-radiation is luminescent, but with lower intensity than water at 20°. Alcohol, ether, chloroform and carbon bisulphide all behave similarly to water. The photographic effects produced by the luminescence of greases and albumen are less intense than those from water. The data show the generality of luminescence phenomena and to a certain degree the identical activity of X, γ and ultraviolet rays. H. H. Ho.

2600. *Duration of Radiation excited in Hydrogen by 10·2-Volt Electron Impacts.* **F. G. Slack.** (Phys. Rev. 28. pp. 1–12, July, 1926.)—By the use of a four-electrode tube, in which high-frequency voltages are applied in phase to the grids of the excitation and photoelectric systems, the life of the 2P state in hydrogen, excited by 10·2-volt electron impacts, was measured. Because of the small amount of hydrogen dissociated by the hot kathode it is improbable that absorption and re-radiation played any part. A discussion of other possible errors leads to the conclusion that the observed effects are due to the persistence of the radiation. The experimental results, which were obtained with tubes of different dimensions and for pressures from 0·075 to 0·25 mm., check well with those calculated on the assumption that starting at the instant of impact the radiation falls off exponentially. The exponential constant found was $0{\cdot}83 \times 10^8$ sec.$^{-1}$. Unless the form of the curve is the result of a lag in the photoelectric effect, as seems improbable, the average duration of the radiation resulting from the 10·2-volt electron impact in hydrogen is $\tau = 1{\cdot}2 \times 10^{-8}$ sec. If the photoelectric lag is effective, this is the maximum value of τ. Preliminary measurements made for the 11·9-volt radiation, attributed to the hydrogen molecule, indicate an approximate value of $\tau = 3{\cdot}5 \times 10^{-8}$ sec. AUTHOR.

2601. *Production of Selective Emission by Flames.* **D. A. Kreider.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 83–86, July, 1926.)—A form of apparatus is described by which illuminating gas, discharging through a type of Bunsen burner, may be loaded with salts whose bases produce notable selective emission. Spraying units are designed to discharge into a single burner if desired, permitting of rapid and easy change from one to another. The flames are remarkably intense and constant. AUTHOR.

2602. *The First Li Spark Spectrum.* **H. Schüler.** (Zeits. f. Physik, 37. 7–8. pp. 568–571, 1926.)—Series and term values of the parlithium spark system are given. Li lines which cannot find a place in any Li spark system are considered as Li arc lines radiated when the two inner electrodes are not in the normal helium order but in that of an excited state. Several tables are given. [See Abstracts 1107 (1925) and 1027 (1926).] E. F.

2603. *Explosion Spectra of Mercury Fulminate and of Certain Azides.* **A. Petrikaln.** (Zeits. f. Physik, 37. 7–8. pp. 610–618, 1926.)—Great attention has been paid recently to the luminescence phenomena of many chemical reactions [see Abstract 2076 (1925)], and the present investigation relates to the explosion spectra of mercury fulminate and of Ca-, Sr-, Ba- and Zn-azides. For mercury fulminate only the triplet series (namely the I and II sub-series) and the resonance line 2536 could be established, whereas for the Ca-, Sr- and Ba-azides the triplet series and also some lines of the singulet group were present. The basic Zn-azides give only the first triplets of the diffuse and sharp sub-series. Mercury fulminate exhibits the cyanogen band-spectrum, while the azides of the alkaline earths give the oxide bands, which are known from the flame spectra. The oxide bands occur only in the long-wave visible region. In all cases the triplet series occur much more readily than the singulet and combination series. Experimental details are included. H. H. Ho.

2604. *Damping of the Resonance Fluorescence of Mercury through Addition of Foreign Gases.* **G. Cario** and **J. Franck.** (Zeits. f. Physik, 37. 9. pp. 619–624, 1926.)—The extinguishing effect on the resonance radiation of adding various gases to mercury-vapour has been investigated. Nitrogen has no marked effect at high temperatures. For a nitrogen-hydrogen mixture the effect is additional at room temperatures, but at high temperatures the effect is greater than that due to each separately. From this result conclusions are drawn as to the effect of collisions on the $2p_2 \longrightarrow 2p_3$ transition. A completion of the work of Stuart [see Abstract 2077 (1925)]. J. E.

2605. *Polarisation of the Resonance Fluorescence of Sodium Vapour excited by the D_2 Line.* **Goverdhan Lal Datta.** (Zeits. f. Physik, 37. 9. pp. 625–638, 1926.)—At a pressure of 10^{-6} mm. Hg the polarisation is 33 %. The difference between the observed values and those indicated by Heisenberg's theory [see Abstract 1358 (1925)] is explained by the distortion produced by neighbouring atoms. The effective radius is calculated on this assumption as 10^{-4} cm. The influence of a magnetic field parallel to the direction of the electric vector was investigated and found to increase the polarisation to 56 %, whence it follows that the effective radius of the atoms is decreased. The effect of potassium and of argon vapour on the polarisation of sodium vapour fluorescence was studied in order to compare the effects of atoms similar to sodium with inactive atoms like argon. Potassium atoms appear to lower the percentage polarisation in a similar way to sodium itself. Argon has apparently no influence. J. E.

2606. *Resonance of Lithium Vapour.* **A. Bogros.** (Comptes Rendus, 182. p. 124, July 12, 1926.)—It is generally accepted that the first doublet of the principal series in the spectrum of alkali metals constitutes the ray of resonance for these metals, but there has been hitherto no direct experimental verification of this except in the case of sodium. This proof is now extended by the inclusion of lithium, resonance having been observed when lithium vapour was illuminated by the principal doublet $1s - 2p_{1,2}$ (6708 Å.). A modified form of Dunoyer's method is adopted [see Abstract 972 (1913)]. When a jet of lithium atoms is bathed by the exciting light, the jet becomes luminous at 540° C., its red tint being the same as that of the incident light. The brightness increases with rise of temperature. A Phillips lamp used as source gave a negative result. G. E. A.

2607. *Absorption Spectra of some Hydride Compounds in the Ultra-Violet.* **E. Hulthèn** and **R. V. Zumstein.** (Phys. Rev. 28. pp. 13–24, July, 1926.)—The vapour of the metal was heated to about 1700° C. in a carbon tube and hydrogen slowly admitted. Under these conditions several hydride bands were absorbed. The four bands found for copper hydride confirm the analysis of Frerichs. Eight silver hydride bands were absorbed which enabled us to form the n_1n_2 scheme. The five gold hydride bands found confirm and extend the work of Bengtsson, and three new bands, farther down in the ultra-violet, indicate a new electronic level. Three aluminium hydride bands were absorbed, which support the analysis of Eriksson and Hulthén. On nearly all our plates the OH bands at 3064 and 2852 were absorbed. Some bands were found which may be due to the oxides of calcium and silver. We were unable to observe absorption at the CdH and CH bands, which are shaded toward the violet. AUTHORS.

2608. *Ultra-Violet Absorption Spectrum of Formaldehyde.* **V. Henri** and **S. A. Schou.** (Comptes Rendus, 182. pp. 1612–1614, June 28, 1926. Nature, 118. p. 225, Aug. 14, 1926.)—The quantification of a molecule can be worked out for the case in which the molecule has an axis of symmetry. No absorption spectrum of this type has been previously found, but formaldehyde vapour is now shown to give a spectrum of this type. The two moments of inertia of the normal molecule are $J_0 = 1{\cdot}41 \times 10^{-40}$ and $K_0 = 25 \times 10^{-40}$. The distance between the hydrogen atoms is $1{\cdot}30 \times 10^{-8}$ cm. and between the carbon and oxygen $1{\cdot}0 \pm 0{\cdot}1$ Å. For the activated molecule the moments are $J_1 = 1{\cdot}56 \times 10^{-40}$ and $J_1' = 1{\cdot}51 \times 10^{-40}$, while the distance between the hydrogen atoms is increased from 1·30 to 1·37 Å, F. S.

2609. *Analysis of the Copper Spectrum.* **W. M. Hicks.** (Phil. Mag. 2. pp. 194–236, July, 1926.)—The paper consists of a discussion of the linkages in the Cu spectrum and includes an attempt to fix the origin and the nature of the Rydberg separations. The existence of linked lines show that the general supposition that all spectral lines are due to the difference of two terms only is too restricted. The paper attempts particularly to discuss the separations in the neighbourhood of 680, 212, 130, 50, pointed out by Rydberg many years ago. The 680 is the ordinary *u*-linkage, but the other three extremely well-marked occurrences have hitherto remained unrelated. The result is to show that (1) the 212 are links formed by Δ or the *d*(1) term in the same way as those already recognised are formed on the *p* and *s* terms, thus further accentuating the great part which the quantity Δ plays in the general constitution of spectra; (2) the 50, 130 seem to be of a quite different nature and to be due to the successive displacements of 108, 268 in *p* terms, that producing the doublet separation of 248·44 being 508; and (3) the properties of Hasbach's satellite system are all related to the *p*(1) series lines, obey very closely displacement rules, and afford direct experimental evidence for the rules of link modification. W. V. M.

2610. *Some Very General Regularities in Optical Spectra.* **K. Bechert** and **M. A. Catalán.** (Zeits. f. Physik, 37. 9. pp. 658–666, 1926.)—The authors attempt to draw conclusions from Heisenberg's *l* classification, particularly from the idea that in complicated spectra several *l* terms can belong to one *k* arrangement, as in Abstract 2279 (1925). It appears that the amount of splitting up of the spectral terms is such that relations can be found between the Δν of an arc spectrum and that of the spark spectrum belonging to the following element in the same horizontal row of the periodic system. In the same way a relation can be given between the Δν values of different multiplicities of the same spectrum. A large number of examples is discussed. H. N. A.

2611. *Shape of the Carbonic Acid Molecule.* **A. Eucken.** (Zeits. f. Physik, 37. 10–11. pp. 714–721, 1926.)—An attempt to show that, contrary to the conception of Schaefer and Philipps [Abstract 2387 (1926)] and Dennison [Abstract 1031 (1926)], the ultra-red spectrum of carbonic acid is consistent with the assumption that the shape of the molecule is elongated. Some further phenomena bearing on the subject are discussed and shown to give strong evidence in support of this assumption. The paper gives two tables and is partly mathematical. E. F.

2612. *Structure of the Arc Spectrum of Manganese.* **J. C. McLennan and A. B. McLay.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 89–120, Jan., 1926.)—An extension of the previous work by the authors on the Mn I. spectrum. The simultaneous work of Zumstein is confimed, and ten additional absorbed wave-lengths are given as well. In all forty wave-lengths have been found to be absorbed by manganese normal vapour. Thirteen pairs of wave-lengths belonging either to the sharp or diffuse subordinate series of aluminium came out as absorptions on the plates, and this is attributed to aluminium impurity in the manganese. Absorbed wave-lengths of Al, Cu, Pb, Bi, Mg or Zn have all been identified, the two former bends obtained only at high temperatures. The work of Catalán, Sommerfeld and Russell is reviewed, and values are given for the terms of a sextet and octet system derived from Catalán's series schemes and multiplets. From the term values so obtained identification was made of two absorbed wave-lengths as $1\sigma - p$, twelve as $1\sigma - \pi$ and six as $1\sigma - \delta'$, whilst three were $1\sigma - \phi$ combinations. For the wave-length λ2173·2 Å. the classification $1\sigma - 2p_{3\cdot 4}$ is suggested, and a new sextet term designated as 5π is suggested from the wave-lengths λ1876·7 Å., λ1875·4 Å., and λ1874·7 Å. The sextet-quartet intercombination multiplets have been identified, and as a consequence the four quartet terms are evaluated, thus extending and revising Russell's work. Five new quartet multiplets have been identified, and these lead to three new quartet terms. Two absorbed wave-lengths have been identified as the sextet-quartet inter-combination lines $1\sigma - 1P_{3\cdot 2}$ (namely λ3224·769 Å. and λ3216·954 Å.). An addendum deals with the recent work of Sawyer on Catalán's classification of three wave-lengths as $1p - 5s$ combinations. Sawyer suggested a possible pp' group in the octet system of the Mn I. spectrum which includes these wave-lengths. An additional line was identified and a new multiplet, No. 14, put forward, which enables the calculation of the $1p'$ terms. Tables are given in illustration of all points. S. G. B.

2613. *Absorption Spectra of some Naphthalene Derivations in Vapour and Solution.* **H. G. de László.** (Roy. Soc., Proc. 111. pp. 355–379, June 2, 1926.)—An examination to determine the effect of the introduction of different groups in the alpha and beta positions of naphthalene as regards its spectrum. It is found that those derivatives of naphthalene containing the groups CH_3, Cl, Br, OH, COOH, Cn and NH_2 show a marked difference in absorption spectra depending on whether the groups are in the alpha and beta positions. The spectra of the beta derivatives are more like naphthalene than their isowers. Both alpha and beta naphthalene spectra consist of two clearly differentiated sections, both as regards position and intensity. In the case of beta-spectra the first part is shifted towards the red more than the second part compared with naphthalene, whilst for alpha-spectra the position is reversed. β-naphthol has an anomalous shift of Section II towards the ultra-violet. The red-shift for naphthalene and benzene derivatives is of the same order, but benzene has the greater value. The Section I of beta-spectra is better defined, intenser and more numerously banded than for alpha-spectra, and contains a prominent band of fine structure in the case of vapour, which corresponds to the C band of naphthalene. The fact that hexane solution spectra are shifted more to the red than vapour phenomena is attributed to an electrical effect in the solution of the nature of a Stark-effect. Tables are given showing the order of increase of intensity with the nature of the added group. The bands of most of the bodies can be resolved into simple series, and it is suggested that the vapour periods are always smaller than those of naphthalene. The calculation of moments of inertia is made from infra-red absorption bands, and the results show that they are less for alpha than for beta bodies. The paper is profusely illustrated by tables. S. G. B.

2614. *Zeeman-Effect in Arc and Spark Spectra of Molybdenum.* **E. Wilhelmy.** (Ann. d. Physik, 80. 3. pp. 305–328, June 2, 1926.)—Zeeman photographs were taken in the second order of a large Rowland spectrograph of molybdenum arc and spark spectra in the region 2500–6000 I.Å. for a field strength of 34,000 gauss. In the arc spectrum the multiplets discovered by Catalán, as well as they could be observed, were collectively verified and two groups given by Kiess were corrected. In the spark spectrum new terms were found which are in agreement with ideas on the relationship between the spectra of neutral and simply ionised atoms. W. V. M.

2615. *Coupling between Elementary Radiative Processes.* **W. Bothe.** (Zeits. f. Physik, 37. 7–8. pp. 547–567, 1926. From the Reichsanstalt.)—Between two pointed counters in close opposition is a copper or iron foil, which is made fluorescent by MoKα rays. It is endeavoured to ascertain whether there are time coincidences between the indications of the counters caused by the fluorescent radiation. The sensitiveness of the counters was increased by various means to such an extent that, according to the absorption statistics of Bohr, Kramers and Slater, coincidences should have occurred in considerable number. The first experiments did show some systematic coincidences, but these were due to unintentional α- and β-rays of radioactive origin. When the counters were constructed of a material showing minimum radio-activity (zinc), no coincidences could be established, although one-fifth of those required by Bohr's statistics would have been perceptible. Hence the processes may be described as "light quanta." Several figures and curves are given. [See Abstracts 47 and 105 (1926).] E. F.

2616. *K Discontinuity of Fluorine.* **Holweck.** (Comptes Rendus, 183. pp. 48–51, July 5, 1926.)—Continuing the work on the spectrometry of the K series of the light elements fluorine is here investigated, and a discontinuity is found at 684·2 volts. The absence of fine structure is noted. W. H. Ge.

2617. *Compton-Effect and Quantum Mechanics.* **G. Beck.** (Zeits. f. Physik, 38. 1–2. pp. 144–148, 1926.)—It is shown that the Compton-

Debye formula for the scattering of Röntgen-rays can be deduced by means of ordinary quantum mechanics. It follows, therefore, that the experimental verification of the formula cannot be interpreted as supporting the extreme form of the quantum theory employed by Compton and Debye in the deduction of the formula. [See Abstract 1115 (1925).]

J. S. G. T.

2618. *Compton Scattering and the Structure of Radiation.* **T. L. Eckersley.** (Phil. Mag. 2. pp. 267–287, July, 1926.)—Compton [Abstract 2194 (1923)], in discussing the scattering of X-rays by free electrons, has evolved a theory entirely discarding electromagnetic laws in favour of quantum considerations. He must have been unaware of J. J. Thomson's investigation [Abstract 915 (1903)], who showed that ions or electrons are set in motion in the direction of propagation of electric waves, so that the scattering is effected by electrons which are moving along with the wave. To a fixed observer the scattered radiation will therefore appear of longer wave-length than that of the exciting source, in agreement with experimental results. The present paper is founded on Thomson's formula, classical methods are employed, and Thomson's analysis is extended to take account of the relativity variation of mass. But, in accordance with quantum ideas, the steady state is calculated, neglecting the action due to re-radiation or scattering, this process being assumed to take place in a sudden transition from one quantum state to another. The steady state is thus unaffected by re-radiation. In the classical theory the change of wave-length is a function of the intensity of the incident radiation. If, in accordance with the experimental evidence, the scattered frequency is only a function of the incident frequency, there must be a restriction on the intensity of the incident radiation. The assumption that this is in quanta is insufficient to determine this relation, for this only fixes the total energy $h\nu$ in the quantum, and not the intensity of E, which determines the change of frequency. In the present theory the relation is provided by quantising the orbit of the scattering electrons, which is found to be periodic. To accept the process outlined here seems more logical than to discard, with Compton, the whole structure of the electromagnetic laws, which are undoubtedly valid in the lower-frequency ranges. The method, using the classical theory to calculate the steady states, and only involving the quantum theory to restrict the possible states (or calculate the arbitrary constants), has the merit of retaining the classical theory as far as possible, and is logically self-consistent if we consider the classical theory as exactly applicable to all periodic or quasiperiodic states of motion, and the quantum theory as a guide to define the possible steady states and the probability of transfer from one state to another. We may obtain a mental picture of the physical processes resulting in the production of a drift of electrons in the direction of propagation, according to the classical theory. Thus an isolated electron in the field of a plane electromagnetic wave will, under the influence of the electric force E, in the first place, execute a valuation to and fro along the lines of electric force, *i.e.* at right angles to the direction of propagation of the waves. But in doing so it cuts across the lines of magnetic force H in the wave front, and is given a resultant forward impulse. It is found that the mean force is zero when averaged over a large number of periods, so that there is no resultant acceleration, and the average velocity given in the first impulse remains unaltered. This average velocity v is a function of the frequency and intensity of the incident radiation, and v/c measures the change of frequency of the scattered radiation. G. W. de T.

2619. *Theories of X-Ray Scattering.* **J. A. Gray.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 181–185, Jan., 1926.)—A short note dealing with certain discrepancies which exist between J. J. Thomson's equations of scattering and experimental observation. Reference is made to the theoretical work of Compton [Abstract 2194 (1923)] and Debye [Abstract 1878 (1923)], and the experimental work of Bragg, James and Bosanquet [Abstracts 1087 and 1773 (1921)], Barkla, Woo and others. A. B. W.

2620. *Scattering of Inhomogeneous Röntgen Rays by Microcrystalline Bodies.* **M. v. Laue** and **H. Mark.** (Preuss. Akad. Wiss. Berlin, Ber. 6. pp. 58–72, 1926.)—After a survey of the literature the authors' own experiments on aluminium rod and diamond powder are recorded. The work was done by a Debye-Scherrer camera. The equation due to Crowther for scattering is explained and applied to a strong increase of intensity for small angles. The apparent differences between theory and practice are explained. S. G. B.

2621. *Distribution of Characteristic X-Radiation at Small Angles.* **H. M. Cave.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 187–188, Jan., 1926.)—As a result of his own experiments, combined with those of Barkla and Ayres [see Abstract 613 (1911)], the author concludes that (1) characteristic radiations are emitted from atoms, on an average, equally in all directions; (2) there are no phase relations between the characteristic radiations emitted by different atoms, or, as Barkla has stated [see Abstract 165 (1918)], the emission of characteristic radiation is absolutely uncontrolled by the primary radiation exciting it. A. B. W.

2622. *Theory of Dispersion of X-Rays.* **R. de L. Kronig.** (Optical Soc. America, J. and Rev. Sci. Inst. 12. pp. 547–557, June, 1926.)—After a brief summary of the ideas underlying the quantum theory of dispersion, it is shown that it can be applied to the refraction of X-rays, although the assumption that the number of atoms in a wave-length cube is large is no longer satisfied. A general formula for the index of refraction in terms of the atomic absorption coefficient α and the critical frequencies is given. From the condition, experimentally verified, that the electrons in the atom for impressed frequencies, large compared to their natural frequencies, shall act like free electrons as far as the index of refraction is concerned, a relation is obtained for α. From the failure of this relation when applied to the groups of electrons separately, conclusions are drawn as to the coupling of the groups. Some considerations on the origin of the Compton shifted radiation are added, from which it appears that in the wave description this radiation must be regarded as coming from all the atoms and as being coherent with the incident waves, a result suited to stress the difficulty of harmonising the wave picture with that of quantum processes in the atoms. Author.

2623. *An X-Ray Spectrograph.* **J. T. Norton.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 231–233, Aug., 1926.)—An X-ray spectrograph of simple construction but of considerable precision is described in detail.

It is of the rotating crystal type and the record is made upon a photographic film bent in the arc of a circle. The instrument is very easy to set up, and the precision of the results is quite good for a device of this type. AUTHOR.

2624. *Effect of Crystal Size on Intensity of X-Ray Reflection.* **R. J. Havighurst.** (Nat. Acad. Sci., Proc. 12. pp. 375–380, June, 1926.)—The author draws the following conclusions as a result of an experimental investigation of the effect of crystal size (using NaCl, CaF_2 and calcite): That primary extinction is absent in crystals that have been grown from solution and ground to less than 10^{-3} cm. in thickness, and that measurements of the intensity of reflection of X-rays by these powders may be used in the determination of electron distributions. Further, in crystals as poor as the alkali halides, single crystal measurements similar to those of Bragg, James and Bosanquet are satisfactory after correction for secondary extinction. A. B. W.

2625. *Intensity of Reflection of X-Rays by Lithum-Sodium and Calcium Fluorides.* **R. J. Havighurst.** (Nat. Acad. Sci., Proc. 12. pp. 380–385, June, 1926.)—The scattering power for X-rays of an atom in a crystal falls off with increasing angle of scattering in a manner that is determined by the electron distribution in the atom. In an effort to determine the electron distribution in certain light atoms the author has made X-ray measurements of the scattering power of powdered crystals of LiF, NaF and CaF_2. The atomic scattering curves obtained show clearly that the assignment of scattering power to atoms in accordance with their total number of electrons is only a crude approximation. "Especially uncertain is this assignment of scattering power in the case of oppositely charged ions (the usual case in crystal analysis) because the excess of positive or negative charge produces a tightening or loosening of the electron atmosphere of the original atom, which profoundly affects its scattering properties." A. B. W.

2626. *X-Ray Levels of the Elements Cu*(29) *to La*(57). **D. Coster** and **F. P. Mulder.** (Zeits. f. Physik, 38. 4–5. pp. 264–279, 1926.)—Bohr and Coster [see Abstract 1398 (1923)] have previously shown that the Moseley curve has a kink in it at certain parts of the periodic table, and that this kink is due to the opening up of a new inner electron group such as one would expect in the iron group, the palladium group and the rare earth group. It seemed to the authors desirable to extend the measurements with greater exactitude to test this point in other regions. The Moseley curves drawn for these results from Cu to La show the same characteristic kinks. A similar change in the optical spectrum at Pd [see Bechert and Catalán, Abstract 1355 (1926)] is related to this work. J. E.

RADIO-ACTIVITY.

2627. *Anomalous Scattering of α-Rays.* **A. Smekal.** (Phys. Zeits. 27. pp. 383–385, June 15, 1926.)—Discusses the views of Debye and Hardmeier on the "subnormal" scattering of α-rays by Al and Mg [Abstract 1842 (1926)], pointing out that there is evidence that the α-particles are not to be regarded as isotropic or as mere points. It is necessary also to consider certain observations which show that for high velocities the scattering of the α-rays becomes normal or even "overnormal"; this seems to lead to the conclusion that the atomic nuclei have a dynamical structure. Debye and Hardmeier seem to assume that every scattering process is due to a completely elastic collision. The results of Bieler, Rutherford and Chadwick do not support this view, while those of Kirsch and Pettersson seem to contradict it. In some cases γ-rays are emitted, and it is suggested that if the nuclei are quantum structures, something like the electron shells outside them, it is probable that when they collide there will be, in addition to elastic collisions, a manifold of inelastic elementary processes similar to those observed when uncharged and charged atomic systems colide. This may include the ejection of protons, the process when the slower H-rays are produced being similar to molecular ionisation and dissociation, while for faster H-rays it resembles corpuscular emission without electromagnetic radiation. H. N. A.

2628. *Long-Range α-Rays from the Active Deposit of Thorium.* **K. Philipp.** (Zeits. f. Physik, 37. 7–8. pp. 518–528, 1926.)—The author has studied the ranges of the α-particles by the scintillation method, and his results confirm those of Meitner and Freitag obtained with the Wilson cloud apparatus. H. N. A.

2629. *α-Rays with a Single Charge.* **S. Rosenblum.** (Comptes Rendus, 182. pp. 1386–1388, June 7, 1926.)—The source employed consisted of active deposit of Th, which was deposited on the edge of a strip of silver or gold 0·05 mm. thick and 8 mm. long; its γ-radiation was equivalent to about 11 millicuries of radium. The rays passed through a slit into the magnetic deviation apparatus, which was covered by a sheet of aluminium 0·05 mm. thick to keep out recoil atoms. The following table gives the positions of the lines due to the ordinary doubly charged α-rays of ThC and ThC′ and of the lines I and II, which were much fainter than these and were half-way between them and the central undeflected line. There was also a faint band nearer to the central line than I and II; a long exposure was necessary.

	ThC.	ThC′	I.	II.
	mm.	mm.	mm.	mm.
I	3·07	2·37	1·49	0·55
II	2·88	2·29	1·53	1·21
III	—	3·60	feeble	1·92

In experiment III the distance from the plate to the source was increased. As to the relative number of singly and doubly charged particles the author gives an estimate of 1 : 1000. H. N. A.

2630. *Power of Certain Metals to Stop α-Rays.* **J. Consigny.** (Comptes Rendus, 183. pp. 127–129, July 12, 1926.)—The power of different metals to stop α-rays has been shown to be proportional to the square root of their atomic weights, but this is only approximately true in most cases, and depends upon the velocity of the rays. Measurements were made to determine the power of aluminium, copper, silver and gold to stop rays for rays having velocities of emission $1 \cdot 59 \times 10$ and $1 \cdot 09 \times 10$ c.g.s. The results were: aluminium 1·53, copper 2·47, silver 3·05, gold 4·13. F. J. B.

2631. *Retardation of α-Rays by Matter.* **S. Rosenblum.** (Comptes Rendus, 183. pp. 198–200, July 19, 1926.)—The active deposit of thorium was used as the α-ray source, and mica, Al, Cu, Ag, Sn, Au, Pt and Pb films as retarders. The velocities of the α-rays were measured by means of a magnetic field of some 15,000 gauss, which was reversed to obtain double deviations. If u denotes the ratio of the initial velocity of αThC′ less the final velocity to the initial velocity, X the superficial masses of the films employed, and N the atomic numbers, the observations $u < 40$ and $N > 13$ can be represented approximately by the equation $X = 7 \log \{(u - 40)/40\}(N + 36)/9$ . . . (1); platinum forms an exception. Apparently the linear relation between X and N for constant u does not hold for small values of N. The more general relation is $X = k \log \{(w + k')/k'\}\{N + K'' - k''/(N + 1)\}$, which is not to be distinguished from equation (1) for high values of N. H. N. A.

2632. *A New Method for Measuring the Absorption of β- and γ-Radiation from Radioactive Bodies.* **D. K. Yovanovitch and (Miss) A. Dorabialska.** (Comptes Rendus, 182. pp. 1459–1461, June 14, 1926.)—Instead of measuring the residual energy of rays which have passed through layers of matter by the ionisation method the authors have attempted to measure the energy retained in the absorber by a calorimetric method. The calorimeter employed has already been described by Yovanovitch [see Abstract 2799 (1924)]. The radium was placed successively inside cylindrical screens of aluminium, copper and lead of known thickness, and the results are shown in curves showing the relation between the calories per gramme of radium per hour and m/s the mass of the screen per sq. cm. As a first approximation $q = Q_\beta(1 - e^{-\mu m/\rho s})$, where q is the excess of the heat measured over that produced by the α-rays and $Q_\beta = 13 \cdot 4$ cal., is the total heat equivalent of the β-rays; μ/ρ for Al $= 51 \cdot 02$; and the values for Cu and Pb do not appear to be very different. The total energy given out by Ra is about 129 cal., which is greater than previously found for the X-rays. H. N. A.

2633. *Absorption of β-Rays by Matter.* **G. Fournier.** (Comptes Rendus, 183. pp. 37–39, July 5, 1926.)—Refers to previous results [see Abstracts 779 and 1055 (1926)], which gave $\mu/\rho = a + bN$ for the β-rays of radium E, where μ/ρ is the mass coefficient of absorption and N is the atomic number of the absorbing element. The same law has now been found to hold for the primary and secondary β-rays of radium and the β-rays of uranium X. The ratio of a to b is in all these cases about 105. The forms of the absorption curves for different β-rays are discussed, and a new experimental method for using powders as absorbers is described. Sulphur forms an exception to the rule. H. N. A.

2634. *Penetrating Radiation.* **E. Condon.** (Nat. Acad. Sci., Proc. 12. pp. 323–326, May, 1926.)—Theoretical considerations as to the possible source of the penetrating radiation discovered by Millikan [Abstract 935 (1926)]. The author suggests a special type of "neutron" to explain the observed facts. A. B. W.

HEAT.

2635. *Expansion of Industrial Glasses.* **M. Samsoen.** (Comptes Rendus, 182. pp. 1384–1386, June 7, 1926.)—A record of experiments on a large number of different glasses, the composition of which is given; the coefficients of expansion at 20° C., the temperatures of transition and the coefficients of expansion above that temperature are recorded. It appears that the additive rule of Winkelmann and Schott is much too simple. In one case, for example, the actual coefficient was $8 \cdot 15 \times 10^{-6}$ while calculation using the above rule gave $6 \cdot 62 \times 10^{-6}$. H. N. A.

2636. *Physical Properties of Well-seasoned Molybdenum and Tantalum as a Function of Temperature.* **A. G. Worthing.** (Phys. Rev. 28. pp. 190–201, July, 1926.)—Spectral emissivity, spectral reflectivity, resistivity, radiation intensity, and thermal expansion measurements as a function of temperature have been made for well-seasoned molybdenum and tantalum. From the data thus obtained values for many other physical quantities as functions of temperature have been computed. As such physical quantities, average visible emissivity, colour emissivity, total emissivity, brightness temperature, colour temperature, radiation temperature, normal brightness, luminous efficiency, and certain temperature variation coefficients have been included. Comparison measurements on moderately pure and very pure molybdenum showed no appreciable variation in radiation properties, though appreciable variations appeared in their resistivities. The results for very pure molybdenum and moderately pure tantalum are incorporated in tables giving values where known for every 200 degrees between room-temperature and the melting-points. [See Abstract 2307 (1925).] AUTHOR.

2637. *A Temperature Scale for Tungsten.* **H. A. Jones.** (Phys. Rev. 28. pp. 202–207, July, 1926.)—In the range from 273° K to 1500° K measurements were made of the resistance of coils of pure, well-aged tungsten filaments (diam. 2·61 mils) placed in the centre of a constant temperature compartment of an alundum resistance furnace through which a stream of pure dry hydrogen was continuously passed. Temperatures were measured by a carefully standardised chromelalumel thermocouple. In the range 1200° K to 3655° K tungsten filaments (V-shape, length 40–50 cm., diam. 2·61, 5·00 and 9·85 mils) were mounted in lamp bulbs and their resistances measured. Temperatures were determined by pyrometering against a standard lamp. The specific resistance of tungsten was found to vary from $5 \cdot 00 \times 10^{-6}$ ohm cm. at 273° K to $117 \cdot 1 \times 10^{-6}$ at 3655° K.

Lamps of the above type were also used to determine the variation with temperature of the energy radiated per $\mathrm{cm.}^2$ of the tungsten filaments. Temperatures from 300° K to 1500° K were measured by the resistance method, from 1500° K to 3655° K by the optical pyrometer. The rate of radiation varied from 0·000016 $\mathrm{watts/cm.}^2$ at 300° K to 399·4 at 3655° K. AUTHOR.

2638. *Melting-Points of Normal Saturated Dibasic Acids.* **D. A. Fairweather.** (Phil. Mag. 1. pp. 944–950, May, 1926.)—The series of normal saturated dibasic acids furnishes a remarkable example of alternation in certain properties between the odd and even members. This effect is most pronounced in the melting-points of the acids. When these are plotted against the number of methylene groups in the chain two smooth curves are obtained, one for the odd and one for the even members. The author has extended the investigation with a greater number of recently prepared acids—with 20, 24, 28 and 32 methylene groups. It appears that the melting-point becomes practically constant when the number of these groups exceeds 16 in the "even" series. The melting-points of the ethyl esters of the dibasic acids have also been determined. The theoretical bearing of the curves connecting the melting-point and the number of CH_2 groups is discussed in relation to crystal structure. A. B. W.

2639. *Anomalous Dilatation of Paramagnetic Nickel-Chromium Alloys: An Alloy for a Dilatation Pyrometer.* **P. Chevenard.** (Comptes Rendus, 182. pp. 1281–1283, May 25, 1926.)—Following experiments with "baros" [see Abstract 924 (1922)] as a possibly suitable alloy for a dilatation pyrometer, more precise measurements, taken over a range between − 195° C. and + 1000° C., reveal a sharp variation, in the neighbourhood of 550° C., in the linear law of dilatation of this alloy. The effects of the addition of small quantities of Fe, Mn, Si, etc., are studied, and the anomalous behaviour is suppressed almost entirely in the alloy: Ni, 82 %; Cr, 7 %; W, 5 %; Mn, 3 %; Fe, 3 %. Such an alloy also possesses satisfactory mechanical properties at high temperatures for this purpose. A. B. C. L.

2640. *Moll Vacuum Thermoelement.* (Journ. Sci. Instruments, 3. pp. 349–350, July, 1926.)—Description of the Moll thermopile [see Abstract 123 (1926)], as manufactured by the Cambridge Instrument Co. A. W. L.

2641. *Thermal Properties of Different Varieties of Selenium.* **P. Mondain-Monval.** (Comptes Rendus, 182. pp. 1465–1468, June 14, 1926.)—Measurements have been made of the specific heats and heats of transformation between the three principal allotropic forms of selenium (vitreous, red crystallised and metallic). The mean specific heats are: 0·084 for metallic selenium over the range 15° to 217°, and 0·078 from 15° to 75°; 0·082 for red crystallised between 15° and 75°; 0·118 for the liquid below 217°. The heats of transformation of vitreous into metallic at 130°, and of red crystallised into metallic at 150°, are 13·5 and 2·2 cal. per gm. respectively. A. W. L.

2642. *Specific Heats of Hydrogen Cyanide.* **J. R. Partington.** (Chem. Soc., J. pp. 1559–1562, June, 1926.)—Commenting on a reply to criticism [see Abstracts 1687 (1925) and 1388 (1926)], it is shown that the reasons advanced against the assumption of Partington and Carroll that HCN vapour is associated to a small extent at room temperature are inconclusive, and that when the qualitative arguments advanced on general grounds are applied quantitatively to the specific case of HCN, they lead to conclusions opposite to those drawn by Edith H. Ingold. It is considered that all the experimental evidence points to association in the liquid state. A. B. C. L.

2643. *Isotherms of Hydrogen, of Nitrogen, and of Hydrogen-Nitrogen Mixtures at 0° C. and 20° C.* **T. T. H. Verschoyle.** (Roy.

Soc., Proc. 111. pp. 552–576, July 2, 1926.)—A special form of steel piezometer was used in these investigations, the details of which are somewhat novel. The origin and purity of the gases are discussed. The units of pressure and volume adopted are the international atmosphere and the normal volume. Isotherms are expressed by developing pv_A in powers of p. Tables of the experimental data obtained for the individual gases and three mixtures at 0° C. and 20° C. are reproduced. A table of the values of the constants in the equations for the several isotherms is given. The final accuracy is about 1 in 1000. The experimental results are compared with those obtained in previous investigations. It is shown that there is no justification for assuming the pv_A values for a mixture to be a linear function of the composition, at least when the critical temperatures of the component gases are widely different.
A. A. D.

2644. *Heats of Combustion of Certain Hydrocarbons.* **D. P. Konovalov.** (Comptes Rendus, 183. pp. 40–41, July 5, 1926.)—Gives the observed values and those calculated from a formula given by the author in 1923 for a number of hydrocarbons; the agreement is good in all cases. Deals with the relation between the term X, which is constant for each homologous series of compounds, and the structures. H. N. A.

2645. *Preparation of Helium Tubes.* **J. Risler.** (Comptes Rendus, 182. pp. 1457–1459, June 14, 1926.)—Describes the precautions to be taken in the preparation of helium tubes so as to eliminate all impurities. Uses the absorption by the alkaline and alkaline earth metals observed by Moissan and studied by Soddy. By a method which is described the vapour of one of these metals is introduced into the tube or lamp which has been evacuated. Helium is then passed in and all its impurities are absorbed by the metal vapour; the line 5875·6 increases in intensity and the whole spectrum of helium appears distinctly. In one hour one gramme of sodium and one of calcium are found to absorb: H 125 $cm.^3$ 130 $cm.^3$, N 135 $cm.^3$ 140 $cm.^3$, CO_2 175 $cm.^3$ 165 $cm.^3$, He 4 $cm.^3$ 4 $cm.^3$, Ne 6 $cm.^3$ 5 $cm.^3$ respectively. In all cases there is complete absorption of all except the rare gases. The method has the advantage of simplicity. H. N. A.

2646. *Solidification of Helium.* **W. H. Keesom.** (Comptes Rendus, 183. pp. 26–27, July 5, 1926.)—This is a brief experimental note concerning the compression of helium in an apparatus composed of brass and german silver tubes. Data are recorded for the absolute temperatures and pressures in atmospheres at which liquefaction of the solidified helium again occurs, *viz.* 4°, 150; 3°, 86; 2°, 50; and 1°, 26. The regularity of the data suggest confirmation of the solidification curve already observed. From about 2° the curve for lower temperatures tends to be almost parallel to the T-axis, indicating that helium does not appear to possess the triple point—solid, liquid, gas. Further compression experiments were carried out in a glass tube furnished with Kuenen's magnetic agitator, when the above observations were confirmed. Solid helium forms a homogeneous transparent mass, whose probable refractive index only differs slightly from that of the liquid.
H. H. Ho.

2647. *The Curve of Fusion of Helium.* **W. H. Keesom.** (Comptes Rendus, 183. pp. 189–190, July 19, 1926.)—The relationship between temperature and pressure for fusion of helium has been determined by the method devised by K. Onnes and van Gulik for hydrogen. Temperatures, deduced from the measured saturation vapour-pressures, extend from 1·13° K to 4·21° K, the corresponding range in pressure being from 25·3 to 140·5 atmos. A. W. L.

2648. *Precise Measurements of Heats of Vaporisation at Low Pressures and Temperatures.* **E. Donath.** (Zeits. Elektrochem. 32. pp. 316–317, July, 1926.)—Illustrated description of an apparatus designed to measure heats of vaporisation with a mean error of about 0·1 % at pressures of about 1 to 150 mm. The paper is partly mathematical and gives three tables of numerical results. [See Abstract 432 (1907).] E. F.

2649. *The Vapour-Pressure Curve and the Molecular Heat of Vaporisation of Fluid Carbon.* **H. Herbst.** (Phys. Zeits. 27. pp. 366–371, June 1, 1926.)—An argumentative discussion showing that the assumption that it is impossible to have a carbon arc lamp above 4200° is incorrect and that it is possible to take the positive crater up to 6000° Absolute—*i.e.* to the apparent temperature of the boiling-point of liquid carbon. The heat of vaporisation is shown from Nernst's equation to be 211 calories if T° is 6000° and the pressure 1 atmos. This value is confirmed by the direct measurements, by Wertenstein and Jedrezejewski, of the loss of weight per unit area and unit time and the heat used during the sublimation of solid carbon. These observers gave a value of 216 calories. If 10 calories approx. is allowed as the heat of fusion, then 206 calories remain for the heat of vaporisation. This is in agreement with the above. The above and like arguments are advanced in support of the primary contention. S. G. B.

2650. *Entropy. Limits of Validity of the Second Law of Thermodynamics.* **R. Plank.** (Zeits. Vereines deutsch. Ing. 70. pp. 841–845, June 19, and pp. 915–920, July 3, 1926.)—In the first part of this discussion the author explains the first and second laws of thermodynamics in the usual elementary manner, and then explains that many molecular phenomena have, during the last twenty years, been investigated which contradict the second law when considered from an energy point of view (*e.g.* Brownian movements). These contradictions can only be explained by the statistical method of considering the meaning of the second law. In the second part of the paper the author gives the relation between entropy and the probability of state, as found by Boltzmann ["Vorlesungen über Gastheorie," I, § 6], and works out the thermodynamic probability and the mathematical probability for the simple case of the expansion of a gas into a vacuum. The thermodynamic probability of a distribution in space is defined as the number of arrangements (*Komplexionen*) of the molecules considered microscopically which can form one macroscopic distribution. The theory of the fluctuations about the equilibrium position is discussed, and the probability of any definite distribution occurring is obtained. The mathematical formula $w_v = w_0 e^{-2v^2}$ for the probability is obtained and its use discussed. The important work of Smoluchowski is referred to, and finally the application of the second law and the probability law problems of life (*e.g.* de Vries mutation theory) are briefly sketched. T. B.

SOUND.

2651. *Acoustic Filters.* **F. Canac.** (J. de Physique et le Radium, 7. pp. 161–179, June, 1926.)—The method of G. W. Stewart [see Abstract 346 (1923)] is employed in the problem of sound filtration, namely by drawing analogies between the passage of sound along a tube and the flow of an alternating current in a conductor. The following analogues are thus brought out: difference of air-pressure and potential difference, velocity of air molecules × section of tube and current intensity, inertance and self-inductance, elasticity and reciprocal of capacity. An acoustic self-inductance is formed by a hole in the side of the tube, and a capacity by covering such an aperture with an elastic membrane. Following electrical diagrams, acoustic inductances and capacities are combined to form filters which are designated "passe-haut," "passe-bas," and "passe-moyen" according to their power of transmitting high, low or medium frequency notes. The regions of filtration of these are then determined experimentally. An oscillating circuit of musical frequency acts on two phones in series; the sounds from the phones pass through two long tubes, the first of which contains a filter. A variable shunt on the second phone allows the sounds to be adjusted to the same intensity. The transmission through the filter is tested over a range of frequency and the results are compared with those found by calculation. It is considered that the use of the sound filter clears up certain problems which have hitherto been treated empirically. G. E. A.

2652. *Shape of Waves from Large Explosions.* **T. C. Sutton.** (Phil. Mag. 2. pp. 137–143, July, 1926.)—The records obtained by Dufour, at Paris, of an explosion at a distance of 180 miles are interpreted according to current theory. The groups of pulses recorded at Paris were composite, and lasted for at least five seconds. During this time the disturbance travelled at least one mile, which is the approximate thickness of the wave-front. At least five series of pressure pulses were formed, and between the passages of the first and second series there was a time interval (1·5 sec.) considerably greater than the corresponding later intervals (> 1 sec.). The rate of change of pressure on the microphones was greatest for the second and third series. [See Abstract 398 (1925).] G. E. A.

2653. *Irregularities in the Sensitivity of the Ear.* **E. Waetzmann.** (Phys. Zeits. 27. p. 455, July 1, 1926.)—Briefly discusses the validity of the conclusions drawn from experiments by Lewschin [see Abstract 2731 (1925)] that the irregularities in the sensitivity of the ear are dependent upon the asymmetrical construction of the tympanic membrane, the maxima being due to natural periods of vibration of the membrane. The resonance conditions in the ear should be included in any discussion on the meaning of the sensitivity curve, but natural periods of vibration of the membrane do not account for depressions in the sensitivity curve as well as for maxima. C. B. C.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

2654. *Einstein's Unitary Theory of [Gravitational and Electrical] Fields.* **V. Fréedericksz** and **A. Isakson.** (Zeits. f. Physik, 38. 1–2. pp. 48–60, 1926.)—The notation of generalised geometry is applied to investigate the difference between the geometry of Einstein's unitary theory and Riemannian geometry. It is shown, *inter alia*, that in the absence of an electromagnetic field Einstein's postulate is a necessary and sufficient condition in order that the geometry of the field may be purely Riemannian. In empty space this postulate is a possible solution of the equations of variation. [See also Abstract 141 (1926).] J. S. G. T.

2655. *Alleged Invariance of Maxwell's Electromagnetic Field Equations.* **E. Brylinski.** (Rev. Gén. d'Él. 20. pp. 85–87, July 17, 1926.)—The author asserts and claims to have proved in this paper that the Galileen transformation leaves Maxwell's equations unchanged and that the belief that this is not so is due to a misunderstanding. G. W. DE T.

2656. *Mathematical Synthesis of the Laws of Electrodynamics.* **H. Malet.** (Comptes Rendus, 183. pp. 191–193, July 19, 1926.)—It is pointed out that regarding the electrical conditions at any point of space, as specified by the assignment of a perturbation vector Φ and a scalar V, then the laws of electrodynamics follow as identical relations if the magnetic force H and the electric force E are defined by the equations $\mathrm{H} = \mathrm{curl}\ \Phi$ and $\mathrm{E} = -\frac{1}{c}\frac{\partial\Phi}{\partial t} + \mathrm{grad}\ \mathrm{V}$. If Φ and V are not further restricted, then a very general system of electrodynamics results, but if the conditions $\mathrm{div}\ \Phi = 0$ and $\nabla^2\Phi - \frac{1}{c^2}\frac{\partial^2\Phi}{\partial t^2} = 0$ are imposed, then the Maxwellian equations are obtained. The alternative conditions, $\mathrm{curl}\ \Phi = 0$ and $\nabla^2\Phi + \frac{1}{c^2}\frac{\partial^2\Phi}{\partial t^2} = 0$, lead to the prequantic equations of Ferrier.

W. S. S.

2657. *A Study of Dipoles.* **L. J. Collet.** (Annales des Postes, Telé. 15. pp. 631–644, July, 1926.)—The author defines a dipole as a system constituted by any assembly of conductors and dielectrics of any shapes and sizes, with two terminals through which the electric currents enters and leaves the system. This is sufficient provided the currents are continuous, and some interesting approximations are obtained. For alternate currents corresponding results can be obtained provided it be assumed that it is possible to define limited systems by means of surfaces on which and outside which the electromagnetic field proper to the system vanishes identically. G. W. DE T.

2658. *Existence of Sub-Electrons.* **J. Mattauch.** (Zeits. f. Physik, 37. 10–11. pp. 803–815, 1926.)—The Ehrenfest-Millikan method for the determination of the charge on small particles gives directly the product $u = eB$, where e is the charge and B the motivity of the particle. Experiments in which the same particle is observed at different gas-pressures enable a curve of u against λ (the mean free path in the gas) to be plotted for each particle. These curves are found to form a series of single parameter families despite the fact that they refer to particles of a number of different substances. For test particles which were repeatedly charged and discharged the curves corresponding to the smallest charge were found all to lie in one family. All the other families could be brought into this one by dividing the ordinates (u) by a small integer. Since the motivity is admittedly independent of e, it is concluded that the smallest charge on all the particles is the same and that the functional dependence of B on λ and a (the radius of the particle) is invariable. Many particles which on the usual assumptions would lead to sub-electrons were found to give curves belonging quite normally to the family referred to above. W. S. S.

2659. *Note on J. Mattauch's Paper on the Existence of Sub-Electrons.* **F. Ehrenhaft.** (Zeits. f. Physik, 37. 10–11. pp. 816–819, 1926.)—The arguments advanced by Mattauch [see preceding Abstract] are criticised on the following grounds: (1) That the curves do not form a single parameter family; (2) that the accuracy claimed for the values of the charge and of the constants in the equation of fall is much greater than is, in fact, attained; (3) that although B as a function of radius, free path, etc., is independent of e, yet it is not admitted that the values of e and B actually found will not show a functional relationship; (4) that the conversion of all the families into one common family in some cases involves dividing u by a very large number, which would correspond to giving the particle concerned a radius five times greater than the true radius; and (5) that the data submitted by Mattauch form merely an abstract of the results obtained, and a certain selection may have occurred. W. S. S.

2660. *A Colloidal Condenser.* **A. Nodon.** (Comptes Rendus, 182. pp. 1270–1272, May 25, 1926.)—Two aluminium plates are separated by a piece of cloth embedded in a paste of colloidal ferric oxide and glycerine. The apparatus, when connected to an a.c. source, exhibits the property of a condenser of large capacity and no leakage. On the other hand, a steady e.m.f. causes an appreciable current to flow between the plates. The dielectric is pierced if the p.d. oversteps 8 to 10 volts. With very small metal surfaces capacities are obtained of the order 500,000 μF. per square decimeter, but with an actual area of 1 square decimetre the capacity is only about 100 to 1000 μF. The condenser does not hold its charge longer than about 1/10 sec. Several applications are described in which this form of condenser may be used. G. E. A.

2661. *A Three-Inductor Static Machine.* **A. W. Simon.** (Phys. Rev. 28. pp. 142–145, July, 1926.)—The quantitative theory of a three-inductor static machine of the Holtz type is given. It is shown that such a machine is essentially a three-phase electrostatic alternator, and that it can be star or mesh connected. A method for demonstrating the action of the machine visually by means of the glow in discharge tubes is described. AUTHOR.

2662. *Lightning.* **N. E. Dorsey.** (Nature, 118. pp. 190–191, Aug. 7, 1926.)—The conception of the lightning stroke given by the author in an earlier paper [Abstract 1884 (1926)] is used to explain the effects shown by Simpson with regard to lightning discharge [Abstract 2159 (1926)]. The author states that while the positive ions from the cloud produce electrons by ionisation in the air, the latter, by their greater mobility, increase the ionisation, and progress continues until the tip is no longer intense enough. By comparison with electric discharge in gases he considers the branching discharge must be due to ingrowth and not outgrowth from the trunk, and the irregularities are determined by the number and distribution of chance electrons. The positive ions merely enhance the charge of the blazed path and the current along it, the path being determined by a succession of negative strokes, each starting from a stray electron at a distance from the tip of the tongue. The advance of a negative tongue is not impossible, but depends upon the conditions of the problem. The tongue will broaden only if no external field exists, but if the longitudinal field is much greater than the transverse field growth will be axial. He conceives two main types of stroke for the object struck: (1) The positive stroke, in which a positively charged tongue of ionised air extends from the cloud to the object; (2) the negative stroke by an electronic dart, of which the highly ionised trail extends from the cloud to the object. In general, the initial effects of the second will be more abrupt, more deep-seated and more rending than those of the first. **G. C. Simpson,** in reply, considers that the ionisation is confined to the immediate neighbourhood of the channel, and that electrons would spread out at the tip of a negative discharge, if such could form, not because of mutual repulsion, but because the field under which the electrons move is divergent at the tip. He considers that this divergence of the field of force prevents the formation and existence of the darts imagined by Dorsey. R. S. R.

2663. *Registrations of the Atmospheric Electric Field at a Height of 20 km.* **P. Idrac.** (Comptes Rendus, 182. pp. 1634–1635, June 28, 1926.)—Ballon-sonde ascents were undertaken in May and June, 1926, from the Trappes Observatory. A two-grid lamp, devised by Lejay [Abstract 2590 (1924)], was used. Under certain conditions the current in the inner grid is a function of the potential across the outer grid, and in conjunction with a milliampere meter the lamp may thus serve as an electrometer to find the variation of the potential across the external grid. The external grid is connected to two points several metres apart vertically, and the indications of the milliampere meter are recorded photographically. Six balloons were subsequently recovered, of which three rose to 13 km. and one to 20 km. The results show a decreasing potential gradient up to 9 km. The three balloons which reached the tropopause show that, in spite of considerable fluctuations, the potential gradient reached a much higher value at this region of 10–12 km., and from the one higher ascent the potential gradient was found to decrease with height in the stratosphere. R. S. R.

DISCHARGE AND OSCILLATIONS.

2664. *Stability of Gas Discharges.* **W. Dällenbach.** (Phys. Zeits. 27. pp. 448–452, July 1, 1926.)—As the result of the investigation carried out in this paper, which is of a mathematical nature, it is concluded that in the glow discharge in the relatively dense mixtures of noble gases, at 13 mm. Hg pressure, the stabilising action may be exclusively ascribed to the inertia of the ions. In other gases, at lower pressures, under 0·1 mm. Hg, the inductivity of the gas tract must also be taken into consideration. [See also Abstract 1628 (1926).] A. E. G.

2665. *The Discontinuous Discharge.* **G. Valle.** (Phys. Zeits. 27. pp. 473–504, July 15, 1926.)—After introducing the subject by describing in detail what is intended to be understood by the term "discontinuous discharge," the following are the main points considered. The elementary theory of the discontinuous discharge; hysteresis phenomena; (*a*) slow hysteresis; (*b*) rapid hysteresis. Typical forms of the discontinuous discharge; special observations on the discontinuous discharge; (*a*) the partial discharge; (*b*) influence of pressure, distance between electrodes, the nature of the gas and electrodes; (*c*) influence of temperature; (*d*) the sensitivity of the discontinuous discharge. A useful list of the literature on the subject is appended. A. E. G.

2666. *Distribution of Energy between Anode and Kathode in the Glow Discharge.* **A. Güntherschulze.** (Zeits. f. Physik, 37. 12. pp. 868–880, 1926.)—The author has previously suggested that for normal kathode fall in hydrogen only a small fraction of the electric energy expended is transferred to the kathode by direct impact of kations, the rest being dissipated in the gas before the kathode [see Abstract 2740 (1925)]. The problem of determining the proportions of this heat energy reaching the anode and kathode respectively is dealt with in the present investigation. The experimental arrangement embodies a water-cooled kathode of aluminium with a plane face over which is suspended a massive copper anode bored to take a sensitive mercury thermometer. With the apparatus filled with hydrogen at 7·5 mm. pressure, the rate of rise of temperature of the anode was measured for a number of anode to kathode spacings. The observations showed that for normal kathode fall the major portion of the energy reaching the kathode was transferred by conduction through the surrounding gas. Experiments were then made using kathodes of iron, aluminium, and magnesium, and working under conditions of anomalous kathode fall with the electrodes in the position of nearest approach. From the results it was deduced that the number of incident kations necessary to liberate one electron from the kathode rapidly decreased with increasing kathode fall, and for a given kathode fall was greatest for the iron, and least for the magnesium kathode.

W. S. S.

2667. *The Cored Carbon Arc.* **M. Wehrli and K. Baumann.** (Zeits. f. Physik, 38. 1–2. pp. 35–47, 1926.)—Anomalies in the characteristic curve relating current to voltage in cored carbon arcs are discussed experimentally and theoretically, and attributed to the co-existence of two limiting types of arcs having hyperbolic characteristics and passing one into the other. The excitation potential of silicon is less than 7 volts.

J. S. G. T.

2668. *Passage of High-Frequency Current through a Glow Discharge.* **B. Klarfeld.** (Zeits. f. Physik, 38. 4–5. pp. 289–303, 1926.)—The resistance of a glow discharge in argon is measured by means of a weak high-frequency current which is superimposed on the direct current.

The resistance of the glow discharge for high-frequency current is inversely proportional to the intensity of the direct current. Other conditions remaining the same, the resistance of the glow discharge depends on the frequency of the alternating current used in the measurement. By increasing the frequency, the resistance becomes greater, but it attains asymptotically a smaller final limit. Between current and tension a phase shift of the order of magnitude 20° is observed with the passage of high-frequency currents through a glow discharge. No simple connection is found between this phase shift and the current frequency. A similar phase shift of approximately the same order of magnitude is observed with a neon glow lamp. The passage of an alternating current through a glow discharge is brought about partly by means of a periodic alteration of the glowing layer of the covered electrode surface and partly through periodic alteration of the current density. A. E. G.

2669. *New Method of Obtaining a Luminous Discharge in Gases at Very Low Pressures.* **E. W. B. Gill and R. H. Donaldson.** (Phil. Mag. 2. pp. 129–137, July, 1926.)—Experiments were made on currents through hydrogen at low pressures: (*a*) with direct voltage, (*b*) with a.c. voltage of frequency about 200,000 per sec., and (*c*) with alternating voltage of frequency about 40,000,000 per sec., *i.e.* for λ about 8 metres. When volts are plotted against pressure, for pressures below $2\frac{1}{2}$ mm. of mercury, in the first two cases the voltage rises as the pressure falls, but in the third case the opposite effect is obtained, and an almost linear relation holds between effective volts and pressure. At a pressure of 1/100 mm. —*i.e.* of the order of pressure in an X-ray bulb—the tube was brightly illuminated under the action of the short waves, the p.d. between the terminals being about 150 volts. The luminous discharge was also observed at pressures less than 1/1000 mm. of mercury. The motions of the electrons are discussed in relation to the conditions under which low-pressure phenomena come into prominence only with very high-frequency e.m.f.'s. G. E. A.

2670. *Distribution of Electric Force in High-Voltage Discharges.* **A. E. M. Geddes.** (Roy. Soc. Edinburgh, Proc. 46. 2. pp. 136–148, 1925–1926.)—In investigation of the kathode fall of potential, Aston found that with voltages up to 1000 volts the electric force in the dark space was nearly in linear relation with the distance from the negative glow, and that practically the whole fall occurred in the dark space between the kathode and negative glow. T. Harris, using voltages up to 1200 volts, found that the fall occurred in the same place, but found no evidence of a sharp discontinuity at the boundary of the dark space and the negative glow, as found by Aston. The present method is similar to that of Aston and Harris, but adapted for high voltages by remodelling, and full details are given. Observations were made on discharges through vacuum tubes where the voltage varied from a few hundred up to 30,000 volts. For voltages up to 13,750 volts the potential difference was found to be confined to the dark space. For higher voltages a portion of the potential difference existed outside the dark space. This portion is roughly one-quarter of the excess of the total voltage over 13,750 volts. The results were compared with the positive-ray method. For voltages under 1000 volts the electric force in the dark space is proportional to the distance from the edge of the dark space. S. G. B.

2671. *Mobility of the Ions in the Corona Discharge.* **W. M. Young.** (Phys. Rev. 28. pp. 129–141, July, 1926.)—The mobility of the ions generated in the d.c. corona discharge have been directly measured. Gas, moving with a uniform velocity, was ionised in a cylindrical corona tube and then passed into an ion chamber consisting of a hollow cylinder with electrodes along the axis. The ion current to the last electrode, when plotted as a function of the cylinder potential, exhibited maxima which indicated the presence of groups of ions. Calculation revealed a large number of groups whose mobilities for oxygen, nitrogen and carbon dioxide were all less than 0·716 cm./sec. per volt/cm., ranging down to 10^{-5} cm./sec. per volt/cm. Nearly all mobilities were found below 10^{-2}, the ions apparently being generated in equal numbers, except now and then a greater number of a certain mobility were formed. The fact that the ions all possessed small mobilities seems to indicate that J. Kunz [Abstract 1366 (1922)] made the correct assumptions when he calculated the average value from the experimental determination of the pressure increase in the d.c. corona. AUTHOR.

2672. *Ionic Mobility in Gases.* **M. Laporte.** (Comptes Rendus, 183. pp. 119–121, July 12, 1926.)—The method previously described of measuring ionic mobilities in gases and establishing the existence of ions of different mobilities is here applied to positive and negative ions in dry, moist and saturated air, and in dry oxygen and nitrogen. The results are given in four graphs. W. H. GE.

2673. *Mobility of Negative Ions in Pure Argon.* **M. Laporte** and **M. A. da Silva.** (Comptes Rendus, 183. pp. 287–289, July 26, 1926.)—The saturation value of the ionisation current in pure argon is reached at 50 volts, whilst for air it is not reached until over 1760 volts are applied. The deformation of the ionisation curve by impurities in the argon has been studied. W. H. GE.

2674. *Dispersion Law of Canal Rays in their Passage through Solid Bodies.* **E. Homma.** (Ann. d. Physik, 80. 6. pp. 609–620, July 24, 1926.)—The present research was undertaken to ascertain whether the dispersion of canal rays in their passage through metal foil follows the same laws as the dispersion of α-rays. Homogeneous hydrogen canal rays and gold foil are used in the experiments. The dependence of the most probable deflection angles on the velocity of the canal rays is investigated with a gold foil of 71 $\mu\mu$ thickness at two different velocities, with a foil of double thickness at three velocities, and with a threefold thickness at one velocity. The canal-ray velocities were in the proportion 3 : 4 : 5. The results show that the most probable angle of deflection is inversely proportional to the cube of the canal-ray velocity. With different thicknesses a of the foil the most probable angle of deflection increases approximately in proportion to $d^{3/2}$. The dispersion law for canal rays here obtained is in good agreement with the law of multiple scattering of α-rays. A. E. G.

2675. *Remarks on the Work of H. Rothe, "Work of Emission with Oxide-Kathodes."* **Annemarie Katsch.** (Zeits. f. Physik, 38. 4–5. pp. 407–410, 1926.)—Rothe has stated [see Abstract 2166 (1926)] that "the grid current commences to flow in consequence of the contact potentials between grid and kathode, first with positive grid tension. With metal kathodes, where there is only a small or no contact potential, the grid current flows with a negative grid tension." Katsch now states that with highly evacuated oxide-kathode tubes the electron current to the grid begins with negative grid tension. In a reply, **Rothe** claims that in the tubes described by Katsch the grid has become covered with scattered oxide and consequently gives results like those obtained with pure metal kathodes. A. E. G.

2676. *The Measurement of Currents by the Electronic Emission from Heated Wires.* **J. Taylor.** (Journ. Sci. Instruments, 3. pp. 347–349, July, 1926.)—The emission from the filament of a thermionic valve furnishes measurements of direct or alternating currents through the filaments provided that the relation between filament current and saturation anode current is known; this is determined for each valve in calibration. Readings on a.c. and d.c. are not in exact agreement owing to the variations of filament current consequent upon the passage of the anode current through the filament. An extreme case is cited for a Marconi Osram valve in which the error in filament current amounts to 1·3 %. A. W. L.

2677. *Equations for Thermionic Emission.* **P. Freedman.** (Nature, 118. pp. 193–194, Aug. 7, 1926.)—In 1923 S. Dushman developed a general equation for thermionic emission in agreement with one of the two equations suggested by Richardson, namely, $i = AT^2 e^{-b/T}$; when i = thermionic current in amps./cm.^{2}, T = absolute temperature, b = constant for the substance, A = a universal constant. A little later, in the same year, Langmuir, as a result of his researches on thermionic emission from thoriated tungsten filaments, proved that the thermionic emission from a body the surface of which is partially covered with a unimolecular layer of another substance, at any temperature, is proportional to $e^{-[b_1\theta + b_2(1-\theta)]/T}$, when b_1 = constant for the substance covering fraction θ of the surface of the body, b_2 = constant for the substance covering fraction $(1-\theta)$ of the surface of the body. So far, A was accepted by all authorities as a universal constant. In the following year, however, K. H. Kingdon, as a result of very accurate observations on election emission from thoriated and cæsiated tungsten, evolved an empirical modification of the thermionic emission equation; namely $i = A_0\{a_1^\theta + a_2^{1-\theta} - 1\}T^2 e^{-[b_1\theta + b_2(1-\theta)]/T}$, when a_1 = constant for the substance covering fraction θ of the body surface; a_2 = constant for the substance covering fraction $(1-\theta)$ of the body surface; A_0 = a universal constant. While the relation between b and the contact potential of a substance has been established by Richardson, no further information on the nature of the a and b constants has been submitted so far. The author has found, on the examination of the latest experimental data, that a can be expressed as an exponential function of molecular volume, $a = Be^{-nv}$, when B and n are constants; b can be expressed as a hyperbolic function of molecular volume, $b = Cv^{-m} - K$, when C, m and K are constants. There certainly may be doubt as to the validity of the "a" equation, as only six elements are available, and of these, three and two each give a common point on the semi-long curve. No such doubt is attached to the validity of the b equation, only one element, sodium, out of the fourteen elements, as divergent as tungsten and cæsium, appearing to be seriously out, and even in that case the discrepancy is capable of reduction in the light of Kingdon's equation. A. E. G.

2678. *Dissociation of Hydrogen Molecules by Mercury Atoms in the Metastable 2^3P_0 Excitation State.* **E. Meyer.** (Zeits. f. Physik, 37. 9. pp. 639–657, 1926.)—Describes a series of measurements carried out in a similar manner to those of Cario and Franck, who illuminated a mixture of mercury-vapour and hydrogen with the line 2536·7 Å., exciting the Hg atoms to the short-lived 2^3P_1 state; these colliding with the H molecules dissociated them, but when the gas-pressure was low, collisions often did not take place before the Hg atoms had ceased to be excited, and then a collision produced no dissociation. The effect thus depended to a marked degree on the pressure. By adding nitrogen to the mixture the author has found that the excited Hg atoms are converted by collision with the N_2 molecules into the metastable 2^3P_0 state; these atoms also dissociate H_2 on collision, the effect being independent of the partial pressure of the hydrogen, since even when this was very small, so that the average time before a collision took place was large, the Hg atom remained excited up to the time of impact. Interesting details of the experimental method are given. H. N. A

2679. *A Supplementary Note to the Paper, "Critical Voltages of Niton."* **F. Struwe.** (Zeits. f. Physik, 37. 10–11. pp. 859–860, 1926.)—The calculation of the ionisation voltage of Nt made by Glockler [see Abstract 593 (1926)] is criticised by the author, who obtains 8 volts instead of Glockler's 9. It is pointed out that while the assumption of direction changes in the curves for Ne and Xe is probably justifiable, the arbitrary amount adopted by Glockler for the Nt curve is incorrect, since a confirmation of the result by means of the Eve law is not possible on account of the great uncertainty of the value for the atomic radius of Nt. [See also Abstract 1637 (1926).] H. H. Ho.

2680. *Distribution of the Directions of Emission of Photoelectrons in Space.* **P. Auger** and **F. Perrin.** (Comptes Rendus, 183. pp. 277–280, July 26, 1926.)—The authors have previously deduced a law for the distribution of these directions with X-rays of moderate frequency. They now deal with the case where the frequency is high and give formulæ which are fairly closely verified by experiments with Wilson's cloud apparatus. H. N. A.

2681. *Fields in Confined Spaces due to Simple Harmonic Electromagnetic Waves.* **T. Sakai.** (Phys. Math. Soc. Japan, Proc. 8. pp. 42–61, March, 1926. In English.)—Owing to the rapid development of wireless telegraphy and telephony in recent years, laboratory experiments have been disturbed by electric waves. A means of keeping a space free from these disturbances is to cover it with metal plates. The object of the present paper is to study mathematically the field in such a shielded space induced by external electromagnetic waves. The analysis deals with three ideal cases: a train of simple harmonic electromagnetic waves strikes (1) a spherical shell *in vacuo*, (2) a space bounded by an infinitely long cylindrical shell, and (3) a space bounded by two thin plane plates extending to infinity. Each of the three spaces is found to be resonant to the incident waves. The conditions of resonance are discussed in each case. G. W. DE T.

2682. *Anomalous Dispersion and Absorption of Electric Waves. Part II.* **S. Mizushima.** (Chem. Soc. Japan, Bull. 1. pp. 83–89, May, 1926. In English.)—It has previously been shown [Abstract 1897 (1926)] that several alcohols exhibit anomalous dispersions of 6·1-metre electric waves, accompanied by anomalous absorptions. The present paper gives the results of similar experiments carried out with waves of 9·5 metres. It was found that water and acetone do not absorb 9·5-metre waves, and that when salts such as NaCl, KI, etc., are dissolved in them the value of I/I_0 depends almost entirely upon the electric conductivity of the solution. I and I_0 are the galvanometer currents in a circuit coupled to the resonance circuit when the test vessel is filled with the liquid and with air respectively. Ethyl ether, like acetone, shows no difference between I and I_0; the values found for the dielectric constant agree with those found by Isnardi and Graffunder for long wave-lengths. With glycerine the anomalous behaviour is quite similar to that at the wave-length of 6·1 metres. A. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2683. *Mechanism of Electrical Conductivity in Metals.* **N. S. Nasarow.** (Phys. Zeits. 27. pp. 455–458, July 1, 1926.)—The most recent theory is based upon the idea of the transference of the valency electron from atom to atom [see Abstract 2835 (1924)]. Certain electrons have the power of absorbing energy, and then become attracted to neighbouring atoms in the course of their rotation round their original nucleus, their places being taken by other unexcited electrons, which in turn take up energy and carry it through the material. When a certain absorption is reached, equilibrium is attained and the conductor is electrified. The effect of heating is to cause the atoms to become farther apart, so that the transference of energy becomes more difficult, the conductivity decreasing. The presence of foreign materials in a metal has the same effect; the existence of atoms of two different kinds in the same material gives rise to the establishment of combinations which are incapable of transmitting energy, and which are thus ineffective as regards conductivity. C. B. C.

2684. *Hall Effect in Pyrites.* **G. Niccolai.** (N. Cimento, 3. pp. 213–217, May, 1926.)—Pyrites not having been hitherto included among the numerous substances investigated in this connection, the author experimented with a natural cube of FeS_2 and found that, as shown in a table, Hall's constant for pyrites has the same sign and order of magnitude as is the case for bismuth. Illustrations of the apparatus are given. It is proposed to continue the investigations in order to ascertain whether the crystallographic properties and anisotropy of the cube have any influence on the Hall effect. E. F.

2685. *Influence of Elastic Deformation on the Magnetic Disturbance of the Supraconductivity of Tin.* **G. J. Sizoo, W. J. de Haas and H. K.**

Onnes. (K. Akad. Amsterdam, Proc. 29. 2. pp. 221–232, 1926. Comm. No. 180(*c*) from the Phys. Lab., Leiden.)—The supraconductive state, in which the p.d. at the ends of a wire through which a current is passing has fallen below the limit of measurement, may be reached by lowering of temperature alone. This state is disturbed by elastic deformation or by the application of a magnetic field. Two wires of extruded tin were tested at a temperature of 3°·415 K under pressures of 4, 100, and 250 kg./cm.^2 respectively. The resistances of the wires were measured while being subjected to a magnetic field. The ratio of the resistance to that at 4°·2 K was plotted with the field, and this ratio was found, in one instance, to increase from zero to 0·96 as the field increased from about 32 to 60 gauss. The magnetic transition curves obtained for rise and fall of field strength do not coincide, but exhibit hysteresis; also the curve for increasing field is shifted towards the field axis by increase of hydrostatic pressure on the wire. These results were confirmed by experiments on the second wire. G. E. A.

2686. *Magnetic Disturbance of the Supraconductivity of Mercury. I and II.* **W. J. de Haas, G. J. Sizoo and H. K. Onnes.** (K. Akad. Amsterdam, Proc. 29. 2. pp. 233–249 and 250–263, 1926. Comm. No. 180(*d*) from the Phys. Lab., Leiden.)—The experiments with tin [see preceding Abstract] gave a hysteresis effect which might be due to the presence of iron, but on extending the tests to mercury the existence of the hysteresis is confirmed, also the presence of sharp discontinuities in the graphs of the magnetic disturbance of supraconductivity. The nature of these graphs is simplified by using materials of single-crystal composition and by improving the homogeneity of the applied field. G. E. A.

2687. *The Effect of a Magnetic Field on the Electrical Resistance of Mercury and some Amalgams.* **Phyllis Jones** and **T. J. Jones.** (Phil. Mag. 2. pp. 176–194, July, 1926.)—Experiments were carried out on the increase of resistance of mercury for values of the current from 0·3 to 1·4 amps. and for fields ranging from 3000 to 10,000 gauss. It was found that for tubes having a diameter of 1 mm. and for small currents that the charge of resistance is independent of the current and is proportional to h^2. With increasing current ∂R eventually became proportional to $h^{1\cdot 58}/i^{0\cdot 4}$. With increasing temperature ∂R is inversely as the viscosity, the results being in agreement with a theory due to E. J. Williams [see Abstract 2148 (1925)] who assumes that the increase of resistance is due to the production of motion in the mercury by the field. ∂R was found to be proportional to the diameter of the tube containing the mercury. The increase of resistance in amalgams was inappreciably different from that in pure mercury for amalgams containing about 0·5 % of Bi or 1·19 % of Zn. Experiments show a slight diminution in ∂R when Bi and Zn are dissolved in mercury, a result to be expected on the theory that in conducting liquids the increase of resistance is produced by motion set up in the fluid. W. V. M.

2688. *The Course of the Isotherms representing the Resistivity and the Thermoelectric Power of Reversible Ferronichels from − 200° to + 1000° C.* **Chevenard.** (Comptes Rendus, 182. pp. 1388–1391, June 7, 1926.)—The isotherms representing the properties of these alloys as a function of the concentration are in general irregular because they are not at the same stage of their magnetic transformation when observed at the same temperature; at high temperatures, however, the transformation has hardly commenced, and at very low temperatures it has nearly finished for all the alloys. The resistivity is plotted against the concentration of Ni for different temperatures. The magnetic transformation shows itself by a change in direction of the curve, the point of greatest curvature coinciding with the Curie point. These points are joined by a dotted curve in the original diagram; it appears to have a noticeable bend at the point corresponding to the alloy Fe_2Ni. The isotherms for thermoelectric power have in general the same appearance as those for resistivity. The general results do not clearly show the existence of the compound Fe_2Ni, but do not contradict it. More definite results could be obtained by means of experiments below − 195° in the neighbourhood of the absolute zero. H. N. A.

2689. *Conductivity and Viscosity of Molten Sodium and Potassium Hydroxides.* **K. Arndt** and **G. Ploetz.** (Zeits. phys. Chem. 119. pp. 439–455, June 30, 1926.)—The conductivity of caustic soda and caustic potash is calculated at various temperatures by extrapolation from values determined in a special apparatus with hydroxides containing varying amounts of chloride and carbonate, the effect of added lime and silica being also determined. Measurements of the density and viscosity were made, the values for the pure hydroxides being determined by extrapolation. The results show that, like the fluoride, the specific conductivity of sodium hydroxide is only slightly greater than that of potassium hydroxide, while with the other salts the factor is about 1·5. For the two hydroxides, the product of the equivalent conductivity and viscosity is constant. Further data are necessary for the elucidation of these problems. B. W. C.

2690. *Influence of Absorbed Gases on the Magnitude of the Photoelectric Effect.* **A. Predwoditelew** and **G. Joffe.** (Zeits. f. Physik, 38. 4–5. pp. 280–288, 1926.)—An investigation into the influence of absorbed air on the magnitude of the photoelectric current in coconut charcoal of known density (1·260 gms./cm.^{3}). The curves of the photoelectric current against the amount of adsorbed gas show pronounced flat maxima. It is shown that there exists a relation between this curve and the magnitude $\partial U/\partial T$, where U = mean energy of the resonator (gas molecule in the adsorbing medium). The magnitude of the flat maximum is determined by the ratio M_1^2/M^2, where M_1 is the electric moment of the dipole in the medium and M that of the free dipolar molecule. J. E.

2691. *The Apparent Antagonism between Short and Long Waves in Interior Photoelectric Action.* **B. Gudden** and **R. Pohl.** (Zeits. f. Physik, 37. 12. pp. 881–888, 1926.)—Discusses the action of short and of long waves of light on the flow of electricity in various crystals as previously described by the authors. The short waves excite atoms or molecules, splitting off electrons which, travelling a larger or smaller distance owing to the action of the electric field, produce the so-called primary current; if long waves are then sent through, the original unexcited condition is renewed, and during this process an additional current flows in the same direction as before [Abstract 662 (1925)]. It is assumed that a space element of the lattice is only able to undergo a certain maximum amount of disturbance by the excitation of its molecules, this maximum depending on the temperature, and that if light is absorbed after this maximum is reached a breakdown takes place and the space element returns to the unexcited state. When excited the absorption in the long wave-length region is increased so that the crystal can absorb long wave-length light, which it does not do when in the unexcited state; the result of this absorption is to raise the excitation up to the maximum, and then further absorption causes a breakdown. After this the long wave-length light is no longer absorbed. H. N. A.

2692. *Photoelectric Conductivity in Rock-Salt.* **A. Arsenjewa.** (Zeits. f. Physik, 37. 9. pp. 701–704, 1926.)—It was found that the electric conductivity of rock-salt previously exposed to X-rays is proportional to the absorbed photo-energy and independent of the wave-length in the region 580–420 $m\mu$. This contradicts the observations of Guylai. Tables of numerical results are given. E. F.

2693. *Effect of Recombination on the Primary Photoelectric Current from a Crystal.* **W. H. Wise.** (Phys. Rev. 28. pp. 57–73, July, 1926.)—Taking into account recombination, mathematical expressions are derived for the primary photoelectric current to be expected from crystals both when the light is normal to the electric field and when the light is parallel and opposite to the electric field. On comparing with the experiments on rock-salt it is found that recombination is sufficient to account for the drop in current with time. The decrease in current when the light is opposite to the field and most strongly absorbed is shown to be partially accounted for by recombination. The effect of the unknown process causing the major portion of the drop is thus isolated and a more rigorous test of any theory which may be proposed to account for it made possible. AUTHOR.

2694. *Theory of Dielectric Polarisation in Salt Solutions.* **L. Ebert.** (K. Akad. Amsterdam, Proc. 29. 3. pp. 454–461, 1926. Comm. No. 56 from the Phys. Lab., Leiden.)—It is shown that the relative number of dipoles fixed by one molecule of the solute may be derived from the specific polarisation of a solution and of the solvent, as given by the dielectric constant. The values calculated in this way for potassium and barium chlorides, cadmium bromide, and tetrapropylammonium iodide at different concentrations agree satisfactorily with those arrived at by other ways. T. H. P.

2695. *Two New Experiments with the Audion.* **Q. Majorana.** (N. Cimento, 3. pp. 218–225, May, 1926.)—The first experiment investigates the photoelectric phenomenon presented by incandescent filaments first observed by Case (Phys. Rev. 17. p. 398, 1921.)—Gibbs and Meacham have observed that the phenomenon does not reach its full intensity instantaneously when the luminous ray acts on the filament, but attains its maximum only in eight to ten minutes and commences to disappear when the light ceases. Arnold and Ives concluded that the increment of the current follows the slight rise in temperature provoked by the light. Admitting this explanation, it might be supposed that the phenomenon is barely perceptible or totally absent when the action of the light is of

very short duration. The author's experiment demonstrates the contrary. Four audions inductively connected were used. Solar rays are concentrated by a lens 10 cm. in diameter on the edge of a revolving disc 30 cm. in diameter having twenty-four perforations. After passing through the disc they are concentrated by a second lens on the incandescent filament of the first audion. The telephone connected with the fourth audion emits a sound corresponding with the rotational velocity of the disc. It is evident that the phenomenon begins to manifest itself in about a ten-thousandth of a second. In the second experiment the first audion was coupled to a small coil, in the interior of which a cylinder of bismuth is placed. The light is thrown on to the base of the cylinder. The sound is more intense when the ray is concentrated on the periphery of the base. The result is not sensibly affected when, by boring out the core, the cylinder is transformed into a ring. If we blacken it and insert a bundle of soft iron wires the sound from the telephone may be heard at a distance of 20 cm. The phenomenon appears to be due to the thermal action of the light. Other metals give either no effect (iron, copper, brass) or a very slight one (zinc). The fact that a current is set up points to some peculiar property of bismuth which calls for further investigation.
E. F.

2696. *Theory of Giebe's Speed-Regulator.* **E. Stoecker.** (Zeits. techn. Physik, 7. 7. pp. 324–330, 1926.)—A complete analytical theory of the speed-regulator referred to in Abstract 1763 (1909). A. H.

2697. *Use of the Quadrant Electrometer in High-Frequency Precision Measurements.* **L. Cagniard.** (Comptes Rendus, 182. pp. 1528–1530, June 21, 1926.)—It is remarked that whilst the employment of the three-electrode valve has rendered easy the determination of small variations of capacity, the results obtained by various observers, given with a precision of 0·1 %, yet vary among themselves by over 20 %. These discrepancies are ascribed to imperfections in the measuring apparatus and to the instability of the valve. In an arrangement of the Wheatstone bridge described advantage is taken of the variation of the capacity of the Moulin-type quadrant electrometer with the position of the needle to obtain results corresponding to a relative variation of capacity of the order of 4×10^{-6}. In a measurement of the variation of the dielectric constant of benzene with pressure, such a variation of capacity corresponds to a pressure variation of the order of 3 cm. Hg. A. B. C. L.

2698. *A Sensitive Quick-Reading Galvanometer with Low Resistance.* **W. J. D. van Dyck.** (Zeits. Instrumentenk. 46. pp. 378–380, July, 1926.)—The galvanometer consists of a half-turn coil of 15 μ diameter copper wire, the ends of which are soldered to two points on a stretched torsion wire of silicon bronze of 11 μ diameter enclosing a rectangular surface 21 mm. long and 1·8 mm. broad. Current enters through one end of the torsion wire and divides at the junction, most of it flowing through the copper half-turn, but some through the torsion wire to the second soldered junction, where the two currents reunite and flow on through the torsion wire. The copper half-coil is balanced by a light mirror cemented to the other side of the torsion wire. The system is placed in the field of a powerful magnet. The half-period of vibration is 0·01 sec., 0·3 microamp. gives 1 mm. deflection with the scale at

1 metre and the resistance as 10 ohms. The copper "loop" being short-circuited by the portion of the suspension wire joining its ends, the instrument is dead-beat. H. N. A.

2699. *Helmholtz Coils for Producing Uniform Magnetic Fields.* **A. E. Ruark** and **M. F. Peters.** (Optical Soc. America, J. and Rev. Sci. Inst. 13. pp. 205–212, Aug., 1926.)—The "Helmholtz coil" is really a pair of coils so proportioned as to produce a magnetic field uniform in magnitude and direction over a large region. The theory of the magnetic field produced by such a coil is briefly developed and the final (series) formula is put into a form convenient for calculations. For ordinary applications only the field at the centre is required. A convenient design, developed for obtaining soft X-ray potentials by determining the velocities of ejected photoelectrons, is described, and is further explained by photographs and drawings. AUTHORS.

2700. *Design of Coils for Oscillation Circuits.* **E. Asch.** (Zeits. techn. Physik, 7. 7. pp. 330–332, 1926.)—The author gives a diagram by means of which it is possible to determine the dimensions of a coil which, when used with a given capacity, will correspond to a given wavelength; or to solve the converse problem of finding the natural wavelength of a circuit consisting of a given capacity and a coil of given dimensions. A. H.

2701. *A Regulator of Voltage and Current.* **P. Vernotte.** (Comptes Rendus, 183. pp. 347–349, Aug. 2, 1926.)—The author describes a method of obtaining a steady supply from a source of varying voltage. Between the terminals of supply are connected two identical circuits, ACB, ADB, of which the parts AC and DB are of unoxidisable silver of resistance R, while the parts CB and AD are of constantan of resistance X. Then the changes in current in a circuit connected across CD are shown to be of the second order compared with those of any changes in the voltage applied to AB. If a second regulator is connected to CD, the resultant current changes will be of the fourth order. Changes in the surrounding temperature can be compensated for by including a resistance of copper with that of constantan. E. T. A. R.

ALTERNATING CURRENTS AND MAGNETISM.

2702. *Electromagnetic Field of a Small Alternating-Current Circuit.* **O. Betz.** (Zeits. techn. Physik, 7. 7. pp. 332–335, 1926.)—An analytical treatment of this problem. A. H.

2703. *Structure of the Atomic Magnet. Existence of a Doublet in Nickel.* **R. Forrer.** (Comptes Rendus, 182. pp. 1272–1275, May 25, 1926.)—It has been shown that, with a certain special treatment, nickel gives a simple hysteresis graph which is an approach to an ideal quadrilateral cycle [see Abstract 2158 (1925)]. Three atomic models may produce the required effect, but it is shown that two of these are inadmissible. The third requires an atomic structure containing two magnetic moments at right angles, one being parallel and the other perpendicular to the field. Rotation of the second of these gives rise to the reversible part of the magnetisation, and reversal of the first accounts for the irreversible part. G. E. A.

2704. *Structure of the Atomic Magnet. Its Normal Position with respect to the Lattice and Remanent Magnetisation.* **R. Forrer.** (Comptes Rendus, 183. pp. 121–123, July 12, 1926.)—Nickel possesses a magnetic doublet and iron a triplet, the constituents of which are at right angles in a zero field. When undisturbed by mechanical treatment and elastic deformation, the multiplet assumes a definite orientation which is symmetrical with regard to the lattice. This is its normal position, and there are two such positions possible in nickel, but only one in iron. Saturation is regarded as due to the closing of the multiplets. Hence if each constituent is given a value 1, the resultant value is in nickel $\sqrt{2}$ and in iron $\sqrt{3}$, and the saturation values are respectively 2 and 3. In a zero field the resultant tends in the direction of the nearest normal position. In a heterogeneous mass of small crystals the remanent magnetisation is an average between the extreme values $\sqrt{3}$ and 1, *viz.* $\frac{1}{2}(\sqrt{3}+1)$. B_s is $4\pi \times 1706$ for iron, and B_r is deduced as $\frac{4\pi}{3} \times 1706 \times \frac{1}{2}(\sqrt{3}+1) = 9760$. High values of B_r are interpreted by supposing two constituents to be parallel and the third to be perpendicular to the other two. This gives a resultant $\sqrt{5}$, and B_r then becomes $\frac{4}{3}\pi \times 1706 \times \frac{\sqrt{5}+\sqrt{3}}{2} = 14{,}170$, which agrees with known values. The two forms in which the iron triplet may exist depend on the presence of slight chemical impurities and on mechanical treatment. [See also preceding Abstract.]

G. E. A.

2705. *Magnetostriction in Permalloy.* **L. W. McKeehan** and **P. P. Cioffi.** (Phys. Rev. 28. pp. 146–157, July, 1926.)—The materials studied comprised iron, nickel, and permalloys containing 46, 64, 74, 78, 80, 84 and 89 % nickel. The method permitted simultaneous measurement of magnetisation and magnetostriction in about 12 cm. at the middle of a 40-cm. wire, 1 mm. in diameter, in an approximately uniform field not exceeding 40 gauss, and either with or without applied tension (within the elastic limit). The magnetostriction was measured by a combination of a mechanical lever, an optical lever, a multiple slit and a photoelectric cell. The magnifying power of this combination, as used, was about 2×10^6, and magnetostrictive strains from 2×10^{-9} to 3×10^{-5} were detected and measured without changing the sensitivity. The magnetostriction-magnetisation curve has an initial slope zero in all the cases studied. When the attainable field was sufficient for magnetic saturation the magnetostriction reached a limiting value. In iron there is evidence for the existence of a Villari reversal in fields too great to be attained in the apparatus. In nickel there is no sign of such reversal. In the permalloys with more than 81 % Ni the magnetostriction is a contraction. In the permalloys with less than 81 % Ni the magnetostriction is an expansion. The limiting values of magnetostriction, when plotted against chemical composition, fall on a smooth curve. Tension increases magnetostrictive contraction and diminishes magnetostrictive expansion. It causes a reversal in the sign of magnetostriction in permalloy with 80 % Ni, a small contraction preceding the final small expansion.

AUTHOR.

2706. *Significance of Magnetostriction in Permalloy.* **L. W. McKeehan.** (Phys. Rev. 28. pp. 158–166, July, 1926.)—Magnetostriction in permalloy, measured by McKeehan and Cioffi [see preceding Abstract], confirms qualitatively the existence of atomic magnetostriction, as previously proposed, and the explanation based thereon for high magnetic permeability and low hysteresis in these alloys. The effect of tension upon magnetostriction suggests that orientation of the magnetic axes of iron and nickel atoms precisely like that due to the application of magnetic fields may be effected by mechanical stresses within the elastic limit. Acceptance of this view makes it possible to explain the large effects of tension upon magnetic hysteresis and the observed relation between the changes in electrical resistance produced by tension and by magnetisation. The occurrence of a reversal of magnetostriction in a stretched wire containing 80 % Ni is covered by the same explanation. A connection between magnetic hysteresis and mechanical hysteresis is suggested, and the molecular field postulated by Weiss is interpreted as the integrated effect of local mechanical stresses. AUTHOR.

2707. *Parallelism between the Phenomena of Magnetostriction and Magnetic Hysteresis in Nickel.* **B. Wwedensky** and **J. Simanow.** (Zeits. f. Physik, 38. 3. pp. 202–214, 1926.)—In a nickel wire 0·5 mm. in diameter magnetostriction and hysteresis phenomena were observed in connection with tensile strain and with various field intensities. The striction curves represented as a function of tensile strain are found, within the limits of observational errors, to follow the same course as the hysteresis curves. This leads to the conclusion that, as maintained by McKeehan and Buckley, striction and hysteresis phenomena are closely allied also in the pure metal. But between magnetostriction on the one hand and magnetisation, remanence and coercive force on the other, there exists no simple parallelism either with a constant field or constant tension. Further, the course of the hysteresis curves represented as a function of the field intensity is quite different from that of the striction curves. Several figures and tables of curves are given. [See Abstract 2764 (1925).] E. F.

2708. *Sensitive Apparatus for Measuring Susceptibility at Different Temperatures.* **G. Foëx** and **R. Forrer.** (J. de Physique et le Radium, 7. pp. 180–187, June, 1926.)—The method used is that of the non-uniform field. By introducing certain refinements, including the use of a delicate but precise translational motion of the specimen instead of torsion, reduction of the mass moved, more perfect damping, and a permanent-magnet dynamometer to measure the force on the specimen, the authors can measure susceptibilities less than $0 \cdot 5 \times 10^{-6}$ (water, $0 \cdot 7 \times 10^{-6}$) on a specimen weighing a few decigrams. G. E. A.

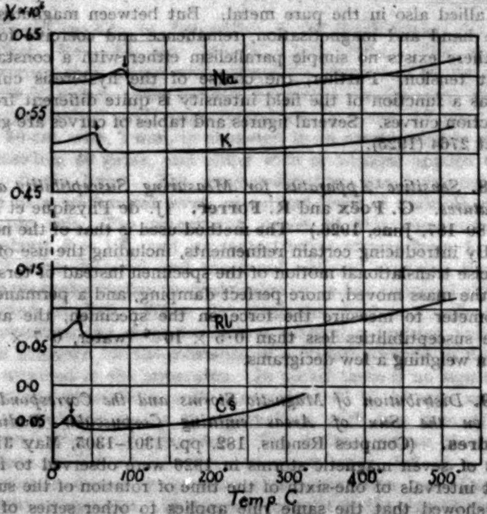
2709. *Distribution of Magnetic Storms and the Corresponding Distribution on the Sun of Areas emitting Corpuscular Radiation.* **H. Deslandres.** (Comptes Rendus, 182. pp. 1301–1305, May 31, 1926.)—A series of seven magnetic storms in 1926 were observed to follow each other at intervals of one-sixth of the time of rotation of the sun. Examination showed that the same rule applies to other series of storms in previous years, but in addition the periods one-twelfth and one-twenty-fourth of the sun's rotation enter. It is suggested that during the months when storms are frequent the sun is divided into six sectors of 60° and that the regions near to six meridians are the seats of intense corpuscular radiation. In these regions deep layers of the sun are brought to the surface and the material in these layers is highly ionised or radioactive. Solar volcanoes arranged as suggested are to be anticipated from knowledge of the way in which cracking occurs in the cooling of a body symmetrical about an axis. For instance, a cooling cylinder of glass cracks along the six diameters of the inscribed hexagon. [See next Abstract.]

A. A. D.

2710. *Distribution of Magnetic Storms and the Corresponding Distribution on the Sun of Areas emitting Corpuscular Radiation.* **H. Deslandres.** (Comptes Rendus, 183. pp. 165–169, July 19, 1926.)—During disturbed periods the sun throws to its surface material from three successive underneath layers. These layers give off corpuscles with an intensity which increases with the depth from which the materials come. The way in which this active matter is distributed on the surface of the sun has been considered in a previous paper [see preceding Abstract]. The magnetic storms do not, however, follow each other at the precise intervals to be expected on the simple view. These anomalies are due to the varying velocities with which the corpuscles are emitted and also to the effect on them of the magnetic field of the sun. **Errata** (*ibid.*, p. 328, July 26, 1926).

A. A. D.

2711. *Magnetic Susceptibilities of some Alkalies.* **W. Sucksmith.** (Phil. Mag. 2. pp. 21–29, July, 1926.)—The variable-field method was employed to measure the mass susceptibility of Na, K, Rb and Cs at



temperatures between 0° and 500° C. for the solid and liquid states. As shown by the curves given, the mass susceptibility increases with decrease of atomic number. The shape of the curves around the melting-point is held to be due to the breaking up of molecular aggregates.

G. E. A.

$CdBr_4K_2$ according to the equation $CdSO_4 + 4KBr = K_2SO_4 + CdBr_4K_2$ in aqueous solution is demonstrated. A. B. C. H.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

2712. *Surface Action.* **R. Dubrisay.** (Comptes Rendus, 182. pp. 1463–1465, June 14, 1926.)—In the adsorption of methylene blue, night blue, congo red, methyl orange and alizarine green by kieselguhr flax and cotton, the quantities adsorbed are determined colorimetrically by comparing the depth of colour of the solution before and after exposure to the solid. A considerable increase in the adsorption occurs when a small amount of sodium chloride is added. A method is also applied in which strips of filter-paper are suspended vertically with the base immersed in the colloid solution. The difference in the heights to which the solvent water and dye respectively ascend is greater when salt is present in the solution. [See Abstract 2205 (1926).] J. N. P.

2713. *Absorption of Hydrogen by Metallic Sodium and Calcium.* **B. Kamieński.** (Acad. Polonaise Sci. et Lettres, Bull. 3–4 A. pp. 109–128, March–April, 1926. In German.)—At 100–110° sodium absorbs hydrogen slowly with formation of the compound NaH. The solid parts of this hydride do not dissolve in the sodium, but the mixture exhibits the melting-point of sodium. Calcium hydride has the heat of formation 42383 ± 296 calories and the melting-point 815·3–817°. The electrical conductivity of the hydride changes twenty-fold at the melting-point and exceeds that of the calcium halides under similar conditions; this behaviour and the value of the melting-point indicate the salt-like character of the hydride. The mean values of the atomic frequencies of calcium and lithium hydrides at the melting-point, derived from Lindemann's formula, are greater than for the corresponding halides, the order of magnitude being hydride, fluoride, chloride, bromide, iodide. T. H. P.

2714. *Adsorption of Iodine by Precipitated Magnesia.* **A. Hamy.** (Comptes Rendus, 183. pp. 129–131, July 12, 1926.)—When a solution of iodine in potassium iodide was brought into contact with a precipitate of magnesia, the magnesia became coloured a reddish-brown. The study of the change showed that the quantity of iodine adsorbed diminished with the age of the precipitated magnesia. The precipitate was rapidly decolorised by alcohol, more slowly by washing the precipitate with potassium iodide solution of the same concentration as that used to obtain the iodine solution. When equilibrium was established, the quantity of iodine adsorbed depended on the concentration of the iodine in the solution. Under suitable circumstances the reaction can be used to detect magnesium. F. J. B.

2715. *Spectrographic Study of Complexes in Solution.* **P. Job.** (Comptes Rendus, 182. pp. 1621–1623, June 28, 1926.)—The complex I_3K in alcoholic solution is studied according to previously described methods [see Abstracts 1762 (1925) and 1685 (1926)]. The results indicate that potassium iodide exists in alcoholic solution in the form $(IK)_3$, reacting with I according to the equation $3I_2 + (IK)_3 = 3I_3K$. The determination of the equilibrium constant of the complex $HgCl_3K$ is effected by the employment of a large excess of KCl. The formation of the complex

$CdBr_4K_2$ according to the equation $CdSO_4 + 4KBr = K_2SO_4 + CdBr_4K_2$ in aqueous solution is demonstrated. A. B. C. L.

2716. *Solutions of Sulphur, Selenium and Tellurium in Pyrosulphuric Acid.* **R. Auerbach.** (Zeits. phys. Chem. 121. pp. 337–360, June 30, 1926.)—The peculiar coloured solutions produced when S, Se or Te are dissolved in the anhydride SO_3 or in the semi-hydrate pyrosulphuric acid $SO_3 . 0{\cdot}5\ H_2O$ (in which these elements are more soluble) have been regarded as solutions of the elements or of some oxygen compounds. The author describes the properties of this pyro-acid, as to which he is not quite in agreement with Knietsch; it has a low heat of fusion (17·9 cal.) and a very high viscosity, and cryoscopic determinations are hence difficult. Sulphur dissolves in the acid as S_2, giving greenish-blue to blue solutions; the oxide S_2O_3 does not appear to be formed. The ordinary metalloidal modification of selenium passes near 130° into the metallic; this inversion can be observed in the finely ground powder and even in the colloidal dispersion of selenium in sulphuric acid, the colour of which changes from brick-red (in reflected light) to black near 130°. In the pyro-acid selenium dissolves as Se_2, and the colour changes near 130° from green into yellow-red, while the Se_2 passes into Se; this change from the molecular into the atomic condition is accompanied by a strong evolution of heat which may become explosive. Tellurium, which is distinctly metallic, dissolves in the pyro-acid as Te. H. B.

2717. *Heats of Solution and Dilution of Salts. Extreme Dilution to Saturation. Part II. Lithium Chloride.* **E. Lange** and **F. Dürr.** (Zeits. phys. Chem. 121. pp. 361–384, June 30, 1926.)—The paper describes improvements of the apparatus [Abstract 2319 (1925)], the preparation of the lithium chloride, and experiments with this salt at 25°. The differential heat of solution diminishes, with increasing salt concentration, much more rapidly (from 8765 to 600 cal./mol.) than with the other alkali salts, and a comparison with the values of Wrewsky and Sawaritzky [Abstract 3080 (1924)] shows that the lithium-ion stands, in this respect, much nearer to the hydrogen-ion than to the sodium-ion. In the LiCl curve there are slight but distinct changes of curvature near 2·5 and 18 mol. LiCl per 100 mol. H_2O. The specific heats of the solutions are measured within two per mille, and the temperature coefficients are determined. H. B.

2718. *The Rôle of Magnetism in Valence.* **E. H. Williams.** (Phys. Rev. 28. pp. 167–173, July, 1926.)—A brief statement concerning the electro-chemical and magneto-chemical theories is made, together with a description of some of the phenomena for which the electro-chemical theory does not give a satisfactory explanation. It is pointed out that one of the tests in favour of the magneto-chemical theory would be the changing of a paramagnetic substance to a diamagnetic substance when the valence is modified so as to change the molecule from one of odd molecular number to one of even molecular number. To test this point measurements were made of the magnetic susceptibilities of a number of carefully prepared compounds of variable valence such as CuO and Cu_2O. The results show that the compounds of Cu, Bi, Pb and Sn of odd molecular number are paramagnetic, while those of even molecular number are

diamagnetic. On the other hand, MnO (odd) and Mn_2O_3 (even) are both paramagnetic, the former slightly more so. CoO (odd) is strongly ferromagnetic, while Co_2O_3 (even) is paramagnetic. AgO and Ag_2O are both diamagnetic, suggesting that possibly AgO is of the form Ag_2O_2 (even).
AUTHOR.

2719. *Molecular Association of Benzoic Acid in Benzene.* **J. A. Wilcken.** (Phil. Mag. 2. pp. 287–288, July, 1926.)—A series of graded solutions are prepared of concentrations varying from 0·040 to 0·546 gm. benzoic acid to 100 gm. benzene, and with these solutions the partition coefficients between pure (conductivity) water and benzene are determined, the titrations being carried out with a standardised baryta solution with phenol-phthalein as indicator, the separating funnel being maintained at 6° C. A diagram is plotted to give the relation between the log of the concentration in benzene and the log of the corresponding concentration in water. It is seen that the slope of the line deviates appreciably from unity, indicating that the condition is not so simple as the formation of double molecules. It is suggested that the process of association passes through a metastable and a labile state, somewhat similar to those of the crystallisation of solutions, as found by Miers and Isaac. [See also Abstract 2189 (1926).] J. N. P.

2720. *Solubility of Beryllium Oxide in Solutions of its Salts.* **N. V. Sidgwick** and **N. B. Lewis.** (Chem. Soc., J. pp. 1287–1302, June, 1926.)—When solutions of beryllium sulphate, selenate and oxalate contain dissolved beryllium oxide, the solubilities of the salts are increased by about 1, 1 and 3 mols. respectively per 4 mols. of the oxide. The results are also given of measurements of the viscosities and conductivities of these and other beryllium solutions, and are, in general, in agreement with the hypothesis that beryllium oxide combines with the beryllium-ion to form a complex kation $[Be, x\,BeO]^{\cdot\cdot}$. T. H. P.

2721. *Method for Determining the Solubility of Sparingly Soluble Substances.* **S. Mitchell.** (Chem. Soc., J. pp. 1333–1336, June, 1926.)—This method, which is of general applicability and yields accurate results, employs an interferometer of the Jamin type, consisting of a double cell through each compartment of which liquids can be circulated. Mercury green light serves as the source of illumination, and both compartments of the cell are first filled with water and the compensator adjusted so that the cross wires of the observing telescope coincide with one of the interference bands. When a dilute aqueous solution is allowed to displace gradually the water in one-half of the cell, the bands are moved, and a fine adjustment on the compensator renders it possible to keep the original band on the cross wires. With aqueous solutions of the various substances examined, with the single exception of benzene, the relation between the concentration and the compensator reading is linear, but this exception renders it necessary in each case to plot a graph between percentage of saturation and compensator reading as a preliminary to the determination of the solubility. When this graph is a straight line, one weighing only is necessary to calibrate the concentration scale, and if the reading for the saturated solution is determined, the weight of the solute present in it may be found graphically by extrapolation. When the graph is non-rectilinear several weighings must be made, and the method loses its simplicity. T. H. P.

2722. *Theory of Concentrated Solutions.* **E. Wilke.** (Zeits. phys. Chem. 121. pp. 401–428, June 30, 1926.)—The potential of a hydrogen electrode in hydrochloric acid solutions increases with the concentration of the latter more rapidly than corresponds to the linear relation between e.m.f. and log C. which is demanded by the Nernst formula. A sharp break in the curve occurs at a concentration of about 0·9 N. The Nernst formula, which assumes the perfect gas law, is modified by applying the van der Waals equation of state. The term a is taken as a measure of the electrical work yielded by dilution of the ionic pairs. By applying Coulomb's law this work is evaluated from the expression $U = \frac{ze^2}{2\epsilon}\int_r^\infty \frac{dr}{r^2}$ for one ion pair, where z is the effective charge, $e = 4{\cdot}77 \times 10^{-10}$ electrostatic units, $\epsilon = 81$ = dielectric constant of water, and $r = l/2$, where $l = \sqrt[3]{\frac{v}{N}}$, $N = 6{\cdot}06 \times 10^{23}$ and v is the volume containing 1 gm./mol. By modifying the Nernst formula in accordance with this departure from the gas laws, an approximate agreement is obtained between measured and calculated potentials. The calculated values are somewhat lower than the measured and the difference is greater at the lower concentrations. The results are related to changes in the value of b in the equation of state. The change which occurs in the radius of the Cl ion with varying concentration of hydrochloric acid is discussed on the basis of the ion forming a cube of eight electrons. It is concluded that the Coulomb law is valid to within 1 % for a cubic ion up to a distance of two or three times the ionic radius, which, in the case of the Cl ion, is taken as $2{\cdot}13 \,.\, 10^{-8}$ cm. The theory which is developed and the measurements made are in close agreement with the Ghosh conception. The mean distance between the ions is proportional to the cube root of the volume on the assumption that the ions are subject to attractive and repulsive forces and to the same spatial relations that apply to crystals.

J. N. P.

2723. *The Velocity of Sol-Gel Transformation with Concentrated Iron-oxide Sols.* **H. Freundlich** and **A. Rosenthal.** (Zeits. phys. Chem. 121. pp. 463–483, June 30, 1926.)—Concentrated Fe_2O_3 sols solidify at suitable electrolyte concentrations to paste-like gels which are "thixotropic," *i.e.* can be liquefied to sols again on shaking. On standing the sol passes into a thixotropic gel again at a definite rate, which is measured. The transformation times are found to be markedly increased by the presence of amino acids, such as glycocoll and alanin, and the effect is attributed to the formation of complexes on the surface of the Fe_2O_3 particles. The α amino acids retard the solidification to a greater degree than those in which the NH_2- and COOH-groups are more widely separated. A sol containing glycocoll exhibits a higher rate of cataphoretic migration than one without, which is attributed to a higher ζ potential of the particles in the former case. The transformation velocity of sol to gel varies with electrolyte concentration in a manner similar to that shown by coagulation velocity. In both cases, at low electrolyte concentrations the velocity increases rapidly with the concentration, and finally reaches a maximum value when the velocity is no longer dependent on the concentration or the nature of the electrolyte. The relation between the transformation velocity and the electrolyte concentration is expressed by a formula which is similar to that derived for the coagulation velocities. J. N. P.

2724. *Supersaturated Mixed Crystals and the Nature of Martensite.* **R. Ruer.** (Zeits. phys. Chem. 121. pp. 484–488, June 30, 1926.)—By means of phase diagrams it is illustrated, in instances where the solvent crystallises out on cooling, how on supercooling a solution the system becomes unsaturated and not supersaturated with solute. Supersaturated mixed crystals are thus shown to arise from a supercooled melt which has become supersaturated with one component. The mixed crystals which separate from this supercooled melt contained a large proportion of the solvent component and a smaller one of the solute component than those which separate from a system which is in equilibrium. From a consideration of these principles it is shown that martensite, which arises from the rapid cooling of austenite when partial transformation into α-ion and carbon or cementite occurs, is not a true solution of these products, but consists of mixed crystals, since α-ion on the one hand and carbon and cementite on the other show no perceptible miscibility in the stable condition. J. N. P.

2725. *Action of Saline Solutions on Ferrous Metals.* **R. Girard.** (Comptes Rendus, 183. pp. 213–214, July 19, 1926.)—Further experiments, with solutions of magnesium chloride and sulphate and calcium sulphate, confirm the tendency of cast irons to form a partly protecting rust and that of steel to undergo destructive corrosion [Abstract 397 (1926)]. T. H. P.

2726. *Corrosion of Aluminium by Water. Part I.* **L. W. Haase.** (Zeits. Elektrochem. 32. pp. 286–289, June, 1926.)—The behaviour of aluminium towards four samples of surface-water, seventeen of drinking-water, and one of sewage-water, ascertained by keeping corked aluminium flasks filled with the water at the ordinary temperature. All the waters attack the metal more or less rapidly, with formation of colloidal and precipitated aluminium hydroxide and sometimes with perforation of the wall of the flask. Measurements of the conductivity show that waters with either high or low hydrogen-ion concentrations undergo alteration in their content of hydrogen or hydroxyl-ions, and also in that of dissociating electrolytes. T. H. P.

2727. *Organo-Gels of the Benzoic Ester of Sorbite.* **P. Thomas** and **Marie Sibi.** (Comptes Rendus, 183. pp. 282–284, July 26, 1926.)—The results are described of experiments made on the organo-gels of the benzoic ester of sorbite which are closely similar to the previously described hydrogels of this ester [see Abstract 1675 (1926)] in their isotropic appearance when viewed under the microscope and on separating into flakes and solvent on shaking. A special study is made of the diffusion of coloured dyes in the alcohol-gel. Benzopurpurine, congo red and night blue diffuse readily, while in the hydrogel these dyes diffuse only with difficulty or not at all. On heating with boiling water, the acetic ester separates into two fractions, one of which dissolves in the water to give a hydrogel on cooling, while the other portion is insoluble. The solubility of the two fractions in other solvents also varies. A similar property is shown by the mannite ester. The differences are attributed to the existence of isomeric forms. J. N. P.

2728. *Zirconium in Colorado Pitchblende.* **O. Free.** (Phil. Mag. 1. pp. 950–960, May, 1926.)—An examination of pitchblende from Colorado has been made by the author, since this is the only important Ur mineral stated to contain zirconium, and because among the U.S.A. uraninites it is unique in being analogous to the Joachimsthal pitchblende. The lead-uranium ratio was very small and indicates a maximum age of two million years. This establishes the recent formation of the mineral in contradiction to the other U.S.A. uraninites examined by Hillebrand and Boltwood. The identity of the constituent thought by Hillebrand to be zirconium has been confirmed, and no thorium or rare earths could be detected in the mineral. Analysis of the mineral gave 78·9 % Ur_3O_8, 5·25 % ZrO_2, with SiO_2 pyrites and moisture as important constituents, and traces of lead, titanium and vanadium. A comparison of the density of the zirconia separated from large quantities of the mineral, with specimens of zirconia separated from a blue Siamese zircon, reputed to be rich in hafnium, and with a commercial zirconia preparation, showed that all these specimens were of similar low density and therefore of similar low hafnium content. The spectra of the preparations were also similar and gave no evidence of any difference in hafnium content. A. B. W.

2729. *Separation of Colloids and Slimes by the Centrifuge.* **J. Dumont.** (Comptes Rendus, 183. pp. 131–133, July 12, 1926.)—The high-speed centrifuge was employed to separate the constituents of earths and clays. It was shown that the precipitate obtained could be divided into two portions, a true clay and a slime formed of particles of less than one-thousanth of a millimetre in diameter. The method was applied to the physical analysis of several different varieties of earth, and the proportions of the various sediments determined. F. J. B.

2730. *New General Analytical Process : Centrifugo-volumetric Analysis.* **R. F. le Guyon.** (Comptes Rendus, 183. pp. 361–363, Aug. 2, 1926.)—Centrifugation is often of use in volumetric analysis in order to collect the precipitate and allow of examination of the behaviour of the clear liquid towards a drop of the indicator. This method, termed centrifugo-volumetric analysis, gives accurate results in the estimation of the orthophosphoric ion by means of standard silver nitrate solution in presence of sodium acetate, and may be applied generally. T. H. P.

2731. *Cementation of Copper, of Nickel and of their Alloys by Tin.* **L. Guillet.** (Comptes Rendus, 182. pp. 1363–1365, June 7, 1926.)—The cementing material was an alloy containing 25 % of tin and 75 % of copper. This alloy has a higher melting-point than pure tin. To it was added 5 % of ammonium chloride. The cementation time was 48 hours and the temperature 700° C. Pure copper and pure nickel offer considerable resistance to cementation, but the alloys are penetrated more easily. In general the cemented surfaces were much harder than the uncemented interiors of the specimens. The possible applications of such cemented alloys is pointed out. [See next Abstracts.] A. A. D.

2732. *The Cementation of Copper and its Alloys by Aluminium.* **L. Guillet.** (Comptes Rendus, 182. pp. 1447–1449, June 14, 1926.)—The cementing mixture was an alloy containing 20 % of aluminium and 80 % of copper. With it was mixed 5 % of ammonium chloride. This latter constituent increases the rate of penetration about three-fold. The results are tabulated for about ten alloys, mostly bronzes and tins. The depth of penetration in forty-eight hours and the hardness before and after cementation are given. [See preceding and next Abstracts.] A. A. D.

2733. *Cementation of Steel by Silicon.* **L. Guillet.** (Comptes Rendus, 182. pp. 1588–1589, June 28, 1926.)—The cementing mixture was ferro-silicon containing 80 % of silicon with or without ammonium chloride or silica. The steel under test contained 0·2 % of carbon. The temperature and time of each experiment were about 1100° C.–1200° C. and three to six hours respectively. The depths of penetration are given. The cemented surfaces were found to contain about 15 % of Si and were very fragile. [See preceding Abstract.] A. A. D.

2734. *Ternary Diagram of the System Iron, Carbon and Copper.* **T. Ishiwara, T. Yonekura** and **T. Ishigaki.** (Tôhoku Univ., Sci. Reports, 15. pp. 81–114, April, 1926. In English. Report No. 118 of the Research Inst. for Iron, Steel and other Metals.)—The equilibrium diagrams for the systems cementite-copper and iron-cementite-copper are considered, especially the latter case. The following equilibria are dealt with: (1) Peritectic equilibrium of pseudo-binary form; (2) invariant equilibrium consisting of two solid and two liquid phases; (3) ternary peritectic equilibrium; (4) ternary eutectoid. The experimental portion of the work is concerned with the determination of the diagram for alloys containing up to 30 % of copper. A. A. D.

2735. *Mechanical Properties of Titanium Steel.* **K. Tamaru.** (Tôhoku Univ., Sci. Reports, 15. pp. 73–80, April, 1926. In English. Report No. 117 of the Research Inst. for Iron, Steel and other Metals.)—The steels tested all contain about 0·3 % of titanium with a carbon content varying up to 0·6 %. The yield-point is less than in plain steels containing the same amount of carbon, and so also is the elongation, which in addition does not depend much upon the amount of carbon present. The contraction of area is much greater than that given by carbon steels. A. A. D.

2736. *Crystals of Aluminium under Compression.* **G. I. Taylor** and **W. S. Farren.** (Roy. Soc., Proc. 111. pp. 529–551, July 2, 1926.)—Small circular discs cut from single aluminium crystals were scribed with parallel systems of lines on the faces and compressed between greased jaws. Measurement of the line systems before and after compression enabled the distortion to be calculated [Abstracts 2032 (1923) and 1764 (1925)]. The results obtained show that the distortion under compression is of the same nature as the distortion which occurs when a uniform single crystal bar is stretched. The distortion is due to slipping parallel to a single crystal plane (111) and in a certain crystallographic direction (110). The choice of which of twelve possible crystallographically similar types of slipping actually occurs depends only on the components of shear stress in the material, and not at all on whether the stress normal to the slip plane is a pressure or a tension. A. A. D.

2737. *Production of Single Crystals of Metals and some of their Properties.* **H. C. H. Carpenter.** (Inst. of Metals, J. 35. pp. 409–437, 1926. Nature, 118. pp. 266–269, Aug. 21, 1926.)—Deals with the production of single crystals by different methods, and gives details of that employed by the lecturer and Miss C. F. Elam in converting the numerous crystals in a sheet of aluminium into a single crystal. The metal was first softened completely by heat treatment, producing new equiaxed crystals of nearly uniform size; the test piece was then strained a definite amount and subjected to a second definite heat treatment, the result being that on an average one test piece in four was converted into a single crystal. A similar method was employed in converting round bars into single crystals. Details are given as to the behaviour of these single crystals under test and cold working and of the orientation of the crystal axis with respect to the axis of the bar in different cases. Single crystals of an aluminium zinc alloy and of iron have been obtained by the same method. The report includes a long bibliography. H. N. A.

2738. *Electronic Affinity of Hydrogen.* **J. Kasarnowsky.** (Zeits. f. Physik, 38. 1–2. pp. 12–21, 1926.)—The electronic affinity of hydrogen could be found from the lattice energy of a hydride, but the theoretical computation of this quantity is at present impossible, because for hydrides as well as for lithium salts the potential of repulsion may not be expressed by a single term with r^{-n}. An approximate result, however, has been obtained by recourse to the experimental lattice energies of the alkali halogenides. For this purpose the author has investigated the alteration in repulsion energy when a kation with eight layers is replaced by one with two layers, and he arrives at the proposition that the lattice energy of an alkali or alkaline earth hydride is almost equal to the lattice energy of an alkali or alkaline earth halogenide of equal molecular volume and like type of lattice. From three separate determinations the expression $E_H - D_H = -62 \pm 4k$ cal. has been derived, from which $E_H = -22\,k$ cal. is obtained, values which are supported by other evidence based on ionic magnitudes and heats of hydration. A negative value for the electronic affinity of hydrogen is not in contradiction with the electrostatic theory of chemical affinity. In contrast to the halogens, the installation of an electron on the atom of hydrogen involves an absorption of energy.
H. H. Ho.

2739. *Thermal Decomposition of Methane at a Glowing Wire.* **G. M. Schwab** and **E. Pietsch.** (Zeits. phys. Chem. 121. pp. 189–208, June 10, 1926.)—Results are given of an investigation on the heterogeneous decomposition of methane into carbon and hydrogen at a glowing platinum strip coated on one side with oxides of the alkaline earth metals, the pressures being a few hundredths of a millimetre. The velocity of the reaction is strictly proportional to the first power of the partial pressure of the methane. As far as the dependence on the temperature is concerned, the impact yields, which are calculated on the assumption of the reaction for an aliquot part of the impacts of the methane molecules on the glowing strip, may be represented by the Arrhenius formula. The heat of activation of the reaction is calculated from the temperature coefficient of the impact yield to be 55,000–60,000 calories. The translational energy of the methane molecules proves insufficient to explain the observed velocities of reaction, it being necessary to take into account the translational or vibrational energy of the affected atoms of the glowing strip or the rotational energy of the methane molecules. The value of the heat of activation indicates that the primary process results in solid carbon and molecular hydrogen. T. H. P.

2740. *Experiments on the Active Modification of Nitrogen.* **P. K. Kichlu.** (Indian Assoc. for Cultivation of Science, Proc. 9. pp. 287–296, June, 1926.)—The author summarises various opinions which have been expressed concerning the nature of activated nitrogen and the mechanism of its action. Using an improved form of tube, described in the paper, for the activation and observation of nitrogen, he has experimented on some of the effects suggested by M. N. Saha and N. K. Sur as means for differentiating between various theories. It is concluded that active nitrogen carries no free charge and no charged particle of N_2. The present work confirms in a general way the observations of Lord Rayleigh, and proves that Na is ionised when acted upon by active nitrogen, as predicted by Saha and Sur. Further experiments are in progress to test Sponer's hypothesis. The author considers that Sponer's theory, in conjunction with Wood's experiments, would lead to the conclusion that the electron in the active nitrogen atom is raised to higher quantum orbits. R. E. N.

2741. *Photolysis of Alcohols.* **Volmar.** (Comptes Rendus, 182. pp. 1607–1609, June 28, 1926.)—The results of experiments on 1 % aqueous solutions of various primary, secondary and tertiary alcohols show that the photochemical decomposition of alcohols under the influence of the radiation of a mercury-vapour lamp occurs in the two stages: (1) dehydrogenation of the alcohol with formation of aldehyde or ketone, and (2) photolysis of the aldehyde or ketone. The reaction is thus completely analogous to the catalytic decomposition of alcohols in presence of reduced metals. Calculation of the wave-length of the radiation capable of causing the dehydrogenation on the basis that the passage from the carbonyl group to the corresponding alcohol grouping involves the rupture of two valencies, and hence the absorption of 88,000 calories, gives in all cases values of about $0 \cdot 19\ \mu$, which corresponds with the limit of radiation of the ordinary lamps and agrees with the direct observations of Berthelot and Gaudechon (*ibid.*, 153. p. 383, 1911). T. H. P.

2742. *Reaction Velocity and Thermodynamics.* **E. Jouguet.** (Ann. de Physique, 5. pp. 470–474, May–June, 1926.)—Certain expressions introduced in a previous paper [see Abstract 1694 (1926)] are more clearly defined and amplified in a theoretical treatment. A. B. C. L.

2743. *Significance of Hydration and Adsorption for the Mechanism of the Production of E.M.F.* **N. Isgarischew.** (Zeits. Elektrochem. 32. pp. 281–286, June, 1926.)—The Nernst equation for electrode potentials, which furnishes no reason for the anomalous behaviour observed with solutions containing a kation other than the metal of the electrode, assumes the existence of free ions. In order to conform to modern views, according to which only hydrated ions are capable of existence, a theory of the mechanism of the formation of e.m.f. is developed on the basis of Fajan's theory of the hydration and solution of solids. T. H. P.

2744. *Nitrogen Fixation in the High-Tension Arc.* **H. V. Tartar** and **M. F. Perkins.** (J. Phys. Chem. 30. pp. 595–616, May, 1926.)—In the fixation of atmospheric nitrogen by the arc process it is found that (1) a high gas velocity through the arc gives a high yield per kw.-hour, but a low percentage by volume of NO; (2) the law of mass action is applicable, as is seen by comparing the results for different mixtures of N and O, and by ascertaining the equilibrium points for various mixtures when samples are passed repeatedly through the arc; (3) the presence of even small quantities of water-vapour cause a material decrease in the yield. C. W. H.

2745. *Aqueous Solutions of Simple Electrolytes.* **H. S. Harned** and **G. Åkerlöf.** (Phys. Zeits. 27. pp. 411–448, July 1, 1926.)—With the object of ascertaining to what extent Debye and Hückel's theory [Abstract 1267 (1925)] is capable of indicating which electrolytes approach closest to the ideal conditions of complete dissociation, measurements have been made of the e.m.f. of a number of cells containing chlorides and sulphates of the alkali and alkaline earth metals. For cells containing a single electrolyte the activity coefficients found are in good agreement with those calculated from the Debye and Hückel constants by means of Hückel's general equations. With cells containing mixed solutions similar agreement is obtained when only chlorides, but not other electrolytes, are present. T. H. P.

2746. *Electrolytic Potential of Iron Amalgam.* **J. Heyrovský** and **B. Souček.** (Comptes Rendus, 183. pp. 125–127, July 12, 1926.)—The electrolytic potential of amalgams is always much more positive than that of the pure metal. The electrolytic potential of iron amalgam is an exception to the general rule. It was found that an iron electrode with drops of mercury deposited on it showed a potential of − 1·115 volts, as compared with that of pure iron, which was found to be − 0·715 volt. The difference was shown to indicate that the direct amalgamation of iron is impossible, and this is borne out by experiment. F. J. B.

2747. *Theory of Electrolytes. Part I.* **L. Onsager.** (Phys. Zeits. 27. pp. 388–392, June 15, 1926.)—The change of the osmotic coefficient with concentration c is given by $g = 1 - a\sqrt{c}$, where a depends upon temperature, valency of the ions and dielectric constant. The empiric formula for the conductivity coefficient is similar: $f_\Lambda = 1 - k\sqrt{c}$; but the k has to be deduced from the observations and cannot be predetermined. In the latter case the decrease of conductivity is, according to Debye and Hückel [Abstract 2541 (1923)], due to two causes, an ionic effect (the charge distribution about an ion is asymmetrical) and the fact that the ion has to drag the solvent with it. Both these effects are proportional to $\sqrt{c}$, but the theoretical proportionality constant k is mostly larger than the observed. Debye and Hückel explain this by assuming that the hydrodynamic laws cannot be applied to ions. The author shows mathematically that the assumed invalidity of Stokes' law in the immediate neighbourhood of the ions would not affect the conductivity, and that the k can be predetermined by substituting for the electrophoretic radius of Debye and Hückel the radius deduced from the ionic mobility. The equations for the calculation of the ionic effect by Debye and Hückel are incomplete in the author's opinion. H. B.